9P

THE PLANT DISEASE REPORTER

Issued By

PLANT DISEASE EPIDEMICS
and
IDENTIFICATION SECTION

AGRICULTURAL RESEARCH SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE

TOMATO LATE BLIGHT: ITS WORLD DISTRIBUTION AND PRESENT STATUS

Supplement 231

April 30, 1955

The Plant Disease Reporter is issued as a service to plant pathologists throughout the United States. It contains reports, summaries, observations, and comments submitted voluntarily by qualified observers. These reports often are in the form of suggestions, queries, and opinions, frequently purely tentative, offered for consideration or discussion rather than as matters of established fact. In accepting and publishing this material the Plant Disease Epidemics and Identification Section serves merely as an informational clearing house. It does not assume responsibility for the subject matter.

Table of Contents

THE PLANT DISEASE REPORTER

PLANT DISEASE EPIDEMICS AND IDENTIFICATION SECTION

Horticultural Crops Research Branch Plant Industry Station, Beltsville, Maryland

TOMATO LATE BLIGHT: ITS WORLD DISTRIBUTION AND PRESENT STATUS

Paul R. Miller and Muriel J. O'Brien

Plant Disease Reporter
Supplement 231 April 30, 1955

INTRODUCTION

In 1946 Phytophthora infestans, without warning, caused an estimated $40,000,000 loss in tomatoes in the United States. In the elements of suddenness and extent of damage, but not, of course, in disastrous consequences, this outbreak was a repetition, after a century almost to the year, of the potato late blight epidemic in 1845 that caused the tragic Irish famine, when millions of acres of potatoes were destroyed in Europe, and in Ireland alone a quarter million people were victims of starvation. Potato late blight again became a major influence in human affairs in the closing year of World War I, when the 1918 epidemic was among the forces that led to Germany's surrender.

The records indicate that these two severe epidemics on potato in Europe resulted from extended periods of very favorable weather coupled with lack of control.

We do not have a satisfactory explanation to account for the outbreak of late blight on tomatoes in the United States in 1946. Records for the eastern half of the country show that the weather was favorable for blight during most of the growing season, and it is true that a high percentage of the southern-grown tomato plants used throughout the area of commercial tomato production were infected. However, in other years when conditions were apparently just as favorable the disease was reported as of minor importance. A study of the various races of Phytophthora infestans that were present during 1946 and subsequent years does not supply any illuminating evidence. In the light of the extensive and intensive observations since 1946 none of these factors alone or in combination seems adequate to explain this third major episode in the history of late blight.

The late blight organism possesses demonstrated flexibility, and further surprises in its development are to be expected. Lack of knowledge concerning the way in which the various forms arise and increase, the place and time of their origin, and the manner of their spread by either natural or other means is a serious matter in view of the known history and recognized potentialities of the disease.

The world-wide survey reported herein is an attempt to obtain clues that might help in answering at least some of these questions. It was restricted to tomato late blight primarily to avoid confusion and bulk. Except for certain details the information for the most part is probably applicable to potato late blight also.

To make this study as current as possible we sent a letter-questionnaire to about one hundred plant pathologists, requesting information on occurrence, distribution, spread, control, economic importance, and strains of the fungus. We appreciate very much the almost universal response to our request. We acknowledge our indebtedness to the individual workers who furnished information for their respective areas, and thank them for their cooperation.

The list of contributors can be found on pages 80-86.

EUROPE

First Report

AUSTRIA:
No report of any outbreak of Phytophthora infestans on tomatoes in Austria.

BALEARIC ISLANDS: See under Spain.

BELGIUM:
Reported in the literature (1921) as occurring on tomato after a particularly wet period. [Cf. Marchal, Él. & Ém., etc.; see Bibliography.]

CANARY ISLANDS: See under Spain.

CYPRUS:
No first date of appearance recorded.

DENMARK:
Tomato late blight was first reported in Denmark in 1888.

ENGLAND:
Published references to the occurrence of potato blight on tomato can be traced back in our early gardening literature to 1878.

ESTONIA [Estonian S.S.R.]:
Reported in the literature (1926). [Cf. Lepik, E., etc.; Käsebier, A., etc.; see Bibliography.]

FINLAND:
First year of definite record was 1931.

FRANCE:
Known to be present.

GERMANY:
Stem and fruit rot of tomato, due to Phytophthora infestans, was reported for the first time in 1907 in the official records of the German Plant Protection Service on the appearance of diseases and parasities.

GREECE:
Reported in the literature (1936) as occuring on tomato in Greece. [Cf. Sarejanni, J. A., etc.; see Bibliography.]

HUNGARY:
An epidemic reported in the literature (1914) as occurring in 1913 which brought about great damage on foliage and fruit. [Cf. von Ruhmwerth, R. Rapaics, etc.; see Bibliography.]
Again reported in 1938. [Cf. Moesz, G., etc.; see Bibliography.]

IRELAND: See under Northern Ireland or Republic of Ireland.

ITALY:
Apparently tomato late blight appeared in the same year as it appeared on potato, namely in 1843 in Lombardy; in the year 1844 in Piedmont, and in the year 1845 it was common in all peninsular Italy.
No authentic early record is available for Sardinia until the first decade of this century. Apparently, however, the disease has been established since the second half of the past century.

NETHERLANDS:
Exact date not known; long known to occur on outdoor tomatoes.

NORTHERN IRELAND:
Late blight of tomato was first reported in Ireland by Professor Johnson of Dublin in 1901. His record appears in the Irish Naturalist, vol. 10: 253. 1901.

NORWAY:
Recorded in 1898.

POLAND:
Reported in literature (1941) as occurring in the districts of Warsaw and Lublin in 1940, leaves and fruits being heavily attacked. [Cf. Minkiewicz, St., etc.; see Bibliography.]

REPUBLIC OF IRELAND:
Phytophthora infestans first recorded attacking tomatoes on September 23, 1914.

ROMANIA:
Reported in the literature (1943) as occuring almost throughout the whole country (in years 1940-41). A particularly heavy attack occurred in the Departments of Botosani, Donohoi, Sibiu, Muscel, Târnava Mică, Alba, etc. [Cf. Săvulescu, T., et al., etc.; see Bibliography.]

SARDINIA: See under Italy.

SCOTLAND:
Blight on tomatoes was recorded first in 1942 but almost certainly had occurred before this date since blight on potato crops has been recorded in Scotland since 1845.

SPAIN:
First reference of Phytophthora infestans on tomato and potato was made by Prof. Ascaratein in "Insectos y Criptogamas que invaden los cultivos en España." Madrid, 1893; no locality given.
It is known to occur in the Baleares Islands. In the Canary Islands it is recorded at Tenerife and Gran Canaria.

SWITZERLAND:
No indications of when tomato late blight was first found in eastern Switzerland.

U. S. S. R.
Reported in the literature (1906) as occurring on July 20, 1903 in a garden in Kursk. [Cf. Bondartseva, A. S., see Bibliography.]
Also reported in the literature (1926) as occurring in and near Leningrad, the tomato fruits being severely attacked and the foliage less severely. [Cf. Bondartseva-Monteverde, V. N., etc.; see Bibliography.]

YUGOSLAVIA:
No record of the first report of tomato blight in Yugoslavia; believe that this disease, however, has existed in Yugoslavia for a long time.

Distribution

BALEARIC ISLANDS: See under Spain.

CANARY ISLANDS: See under Spain.

CYPRUS:

Cyprus
(Chamberlin Trimetric
Proj. *118.4 miles to the inch)

Records have indicated its presence in the Paphos district, the Nicosia district, and in the Famagusta district.

* For all the individual country maps the scale indicated is before the uniform 25 percent reduction. See inside back cover for the world distribution map.

DENMARK:

Tomato late blight can be found in all parts of Denmark.

Denmark
(Chamberlin Trimetric Proj.
118.4 miles to the inch)

ENGLAND:

The disease is recorded from most parts of the country every year. As most of the outdoor crops are grown in the southern counties, it is usually only of economic importance there although it is occasionally serious in unheated houses in northern districts.

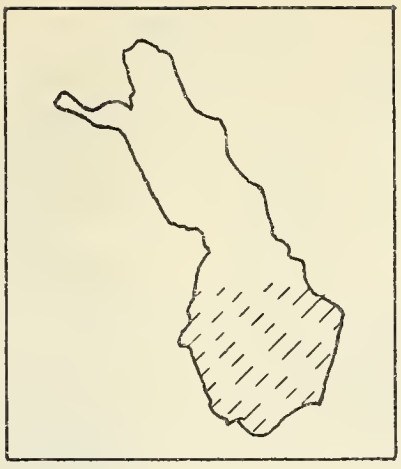
In Yorkshire and Lancashire the crop is not grown out of doors but is grown a great deal in unheated Dutch glass structures particularly in East Yorkshire. The large ventilators are left permanently open in the summer and spores of the blight fungus often get in an infect the leaves situated near the ventilator and many of the fruits.

England and Wales

(Chamberlin Trimetric Proj.
118.4 miles to the inch)

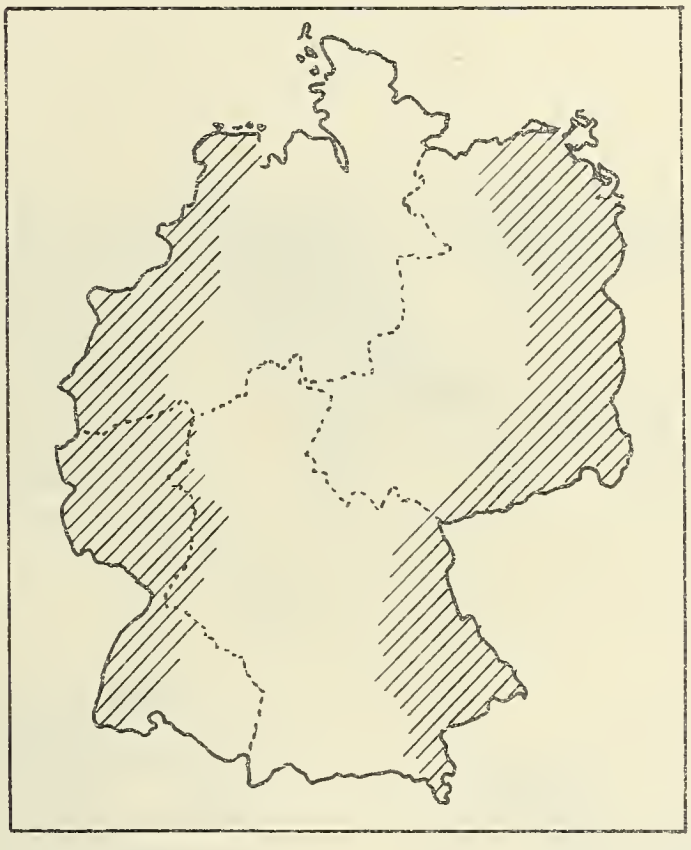
FINLAND:

According to a rough estimate, the northern limit of the occurrence of late blight on tomato might be the 64th latitude.



Finland
(Van der Grinten's Proj.
632 miles to the inch)

GERMANY:



Germany
(Chamberlin
Trimetric Proj.
118.4 miles
to the inch)

The disease is widespread both in West and East Germany, differing in intensity according to weather conditions and the control measures taken. In years of severe attack of Phytophthora on potato, as for example 1951 and 1954, tomatoes are also usually affected; however, more or less local loss is regularly reported in other years in nearly all parts of the country.

Since the fungus requires moisture and heat for its development, it is found especially in localities having a high degree of precipitation in summer and a high air-humidity. Such conditions prevail at least at times throughout Germany during the months from July to September, owing to frequent showers, and favor outbreaks of the disease.

GUERNSEY (Isle of):

Tomatoes grown almost wholly as a glasshouse crop.

IRELAND: See under Northern Ireland or Republic of Ireland.

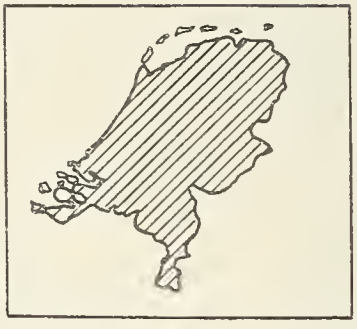
ITALY:

Italy
(Van der Grinten's Proj.
395 miles to the inch)

The distribution of tomato late blight is universal because of the moist spring and first half of summer in northern Italy and the rainy winter and first half of spring in the south of Italy.

The greatest bulk of production of tomatoes is in northern Italy, both for fresh fruits and tomato paste; second highest is the production in southern Italy, also for fresh fruits and for the peeled fruit industry. The small production of insular Italy is confined almost totally to Sicily. It is interesting for the production, under culture in the open air, and exportation of very early green fruits.

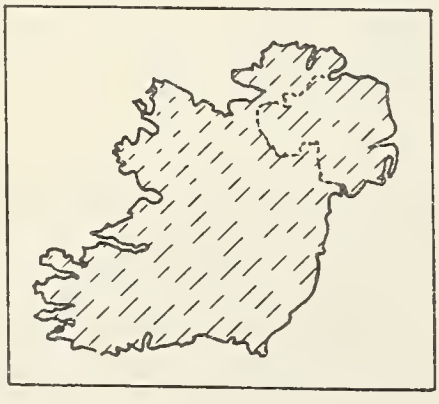
NETHERLANDS:



Netherlands
(Chamberlin Trimetric Proj.
118.4 miles to the inch)

Present over the country but exclusively or almost exclusively on outdoor tomatoes. Outdoor tomatoes are grown mostly in the western and southern part of our country. The area of outdoor tomatoes is small in comparison with that of the glasshouse tomatoes.

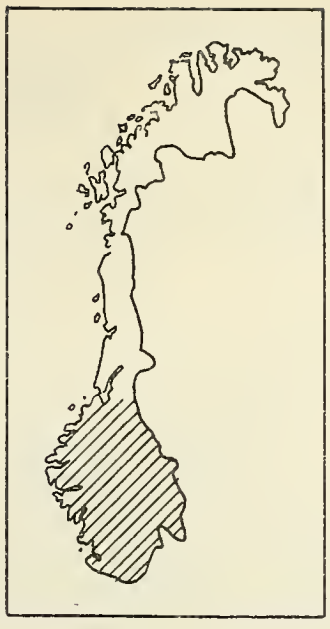
NORTHERN IRELAND:



Northern Ireland
and
Republic of Ireland
(Chamberlin Trimetric Proj.
118.4 miles to the inch)

Late blight of tomato is of common occurrence in Northern Ireland but it cannot be regarded as a major disease of this fruit. The climate is not suitable for growing outdoor tomatoes but if the crop is grown out of doors, late blight can be a serious problem. It is seldom if ever seen on tomato crops growing in heated glasshouses but it does occur now and again on the crop being grown in unheated glasshouses. In such cases it is commonly found attacking plants growing near a ventilator or which have very close access to the conditions obtaining outside the house. It has been seen, for instance attacking a truss of fruits which had grown through a ventilator and were exposed to the outside air.

NORWAY:



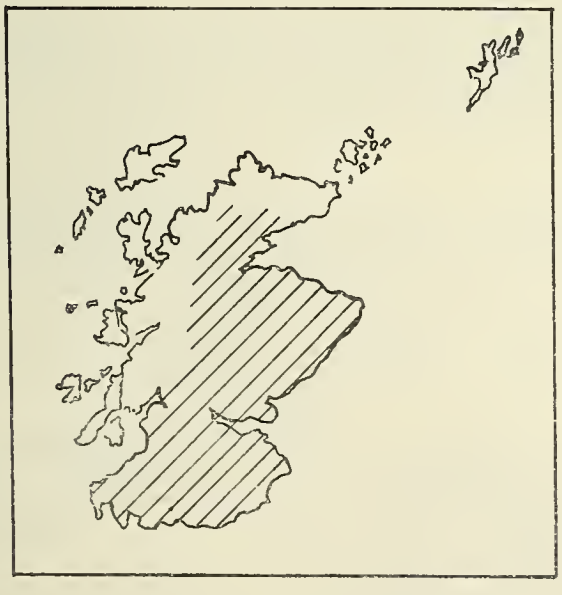
Norway
(Van der Grinten's Proj.
632 miles to the inch)

Southern Norway northwards to Trøndelag (district around Trondheim).

REPUBLIC OF IRELAND:

Wherever tomatoes are grown outside in this country, Phytophthora infestans invariably appears on the plants during September and October. In bad seasons it may be present during the month of August. [See with Northern Ireland for map.]

SCOTLAND:

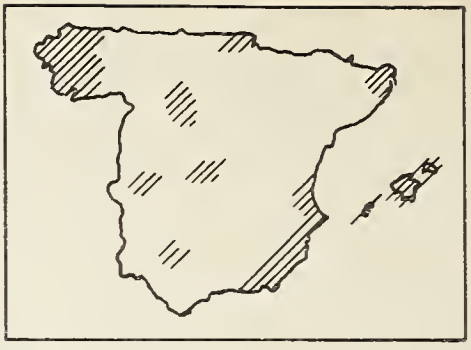


Scotland
(Chamberlin Trimetric Proj.
118.4 miles to the inch)

It has been reported from all areas wherever tomatoes are grown commercially in main drainage areas of Solway, Clyde, Tweed, Forth, Tay, Dee and Moray.

SPAIN:

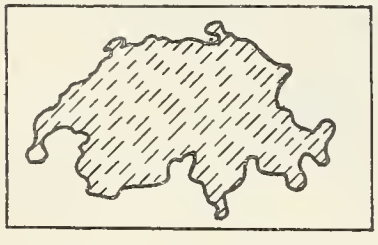
Canary Islands
(Chamberlin Trimetric Proj.
189.4 miles to the inch)



Spain
and
Balearic Islands
(Van der Grinten's Proj.
395 miles to the inch)

The provinces of Spain in which Phytophthora infestans attacks tomatoes are: Alicante, Almeria, Caceres, Coruña, Lugo, Gerona, Guipúzcoa, Murcia, Orense, Sevilla, Toledo, Valencia, Valladolid, Baleares, Gran Canaria, and Tenerife.

SWITZERLAND:



Switzerland
(Chamberlin Trimetric
118.4 miles to the inch)

No visible differences in regional distribution; appears here and there.

YUGOSLAVIA:

Tomato late blight is distributed in the following republics: Macedonia, Serbia, Montenegro, Bosnia-Herzegovina, and Croatia.

Yugoslavia
(Van der Grinten's Proj.
395 miles to the inch)

Spread; Environmental and Geographic Factors Involved; Potential Danger Spots

CANARY ISLANDS:

In the Canary Islands infections are favored by windless nights with dew; attack is principally on the under parts of the plant stalk and following a wilt on the upper ones. Plants are close and the under parts are less exposed to the winds and more exposed to infection. Also, tomato fruits are sometimes attacked.

CYPRUS:

Cyprus has no information available regarding the method of infection.

DENMARK:

We are growing a lot of potatoes in most parts of Denmark, and it seems that blight is spread to the tomatoes from the potatoes. No part of Denmark is further than 100 kilometers from the sea, and the weather in August and September often is very humid. In most years we find blight on tomatoes all over the country.

There seem to be no special potential danger spots.

ENGLAND:

Spread is by air-borne spores and is favoured by the damp, warm "blight" weather we experience here in late summer about one year in three.

FINLAND:

It is thought that potato fields are the most important source of late blight infection on tomato and the environmental conditions which favor potato late blight infection increase the spread of Phytophthora onto tomato.

GERMANY:

Information in regard to the spread of the disease is not available in any detail. Dispersal of the conidia by wind and water is an important factor.

The regions in which the disease is particularly serious have not yet been determined.

IRELAND: See under Northern Ireland or Republic of Ireland.

ITALY:

Wind and rain are the principal means of spread. The general weather of the season is greatly modified by the local topography, with local endemic "spots" as source of inoculum. One must remember the very uneven geographical situation of Italy, including the fact that the great culture of tomato in north Italy is localized near the pedemontain border of the Appennines.

JERSEY (Isle of):

Tomatoes are interplanted with early potatoes and experimental evidence suggests that whilst the potatoes are very susceptible to infection by conidia from the tomatoes, the reverse is not true, as tomatoes are little affected by blighted potatoes growing nearby.

MALTA:

Usually after rains which are rather infrequent at the time of maturation of tomato crops.

NETHERLANDS:

Wind dissemination. Source of infection presumably always potatoes. Potatoes are grown intensively all over the country. Every year to a greater or lesser extent they are attacked by Phytophthora.

NORTHERN IRELAND:

Owing to the endemic nature of potato late blight in Northern Ireland, the same might be said to hold for the organism attacking tomato; presumed that the pattern of spread would closely follow that for late blight of potato.

NORWAY:

Late blight is always spread as conidia from potato fields and is nearly always found on tomato fruits only (not often on the leaves), mostly on tomatoes in the open and in non-heated houses. Tomatoes far from potato fields are usually not attacked.

REPUBLIC OF IRELAND:

The principal method of spread here appears to be the wind. The potential danger spots are neighbouring potato crops.

SCOTLAND:

In general, the disease is of very minor importance in even the more concentrated tomato-growing area in the Clyde Valley. The principal factor here is that, in general, potato crops -- except early varieties which ripen-off before blight becomes active -- are not grown near to commercial tomato glasshouses.

SWEDEN:

Most outbreaks occur on tomatoes grown outdoors, and the outbreaks are more common and also more severe in years when the potato blight causes the most damage.

Outdoor tomato growing is mostly non-commercial; the commercial growing being done under glass. The climatic conditions are very often not favourable for outdoor growing, especially in the northern half of the country.

SWITZERLAND:

Occurrence seems to be conditioned by climatic factors. In wet seasons the disease is rather frequent, while in dry summers it is of no practical importance.

YUGOSLAVIA:

Spread mostly by wind, especially where there is moisture in abundance and where tomato plants are not tied.

Damage

DENMARK:

Most of our tomatoes are grown in greenhouses and there we have full control over blight. We grow tomatoes in open land in all parts of Denmark but on a very small scale. It is, therefore, impossible to estimate the damage. In very humid and warm years (August-September) up to 90 percent of the crop can be damaged if we do not spray.

ENGLAND:

No reliable figures are available for losses caused; in "blight" years, however, rotting of the fruit, particularly in unsprayed outdoor crops, is often very considerable.

The damage in Yorkshire and Lancashire is not as a rule very great but in one season out of three it may spoil 1 to 5 percent of the fruits picked during late August and September.

FINLAND:

According to investigations on potato late blight in Finland, losses due to this disease are most severe in spots of low altitude and on sea shores where the air humidity is high. Losses in potatoes are more prevalent on clay soils.

GERMANY:

Figures on the extent of damage caused by the disease, particularly the quantity or value of losses, are not at hand. It has not infrequently been estimated, however, that up to 80 percent of the crop of Freiland tomatoes has been destroyed by Phytophthora.

IRELAND: See under Northern Ireland or Republic of Ireland.

ITALY:

It is almost impossible to calculate the amount of damage caused by tomato late blight be-

cause this pathogen is associated usually with other tomato diseases. Very frequently two or more pathogens are found in the same field if not on the same plant.

A rough estimation of total loss of tomato fruits (including wilt which is very serious; mites; blossom-end rot; Fusarium rots; Phoma rot, etc.) is variable, from 15 to 30 percent.

MALTA:

Slight, almost negligible.

NETHERLANDS:

Loss estimated in severe blight years 50 to 80 percent; in moderate blight years 10 to 20 percent.

NORTHERN IRELAND:

Amount of damage caused by tomato late blight is insignificant on account of the negligible amount of the crop grown out-of-doors.

NORWAY:

Amount of damage not known. Tomatoes grown in the open and in non-heated houses are not an important crop in Norway and the losses consequently are of minor economic importance.

REPUBLIC OF IRELAND:

In the years favourable to the disease the entire crop may be lost. In years of moderate infection, one-quarter of the crop may be blighted.

SCOTLAND:

In years when potato blight is rampant, only small losses occur to tomatoes under glass. Loss is almost negligible in years of slight to moderate potato blight.

SPAIN:

In the south of Spain and partially in the east (Levante) the greater damage is done in the rainy springs. The summer tomato is not generally affected, not only because of the dryness, but also because the temperatures are sufficiently above the optimum and sometimes over the maximum.

At Castilla and Aragon, in the center of Spain, the tomato is cultivated in summer and Phytophthora attacks are rare due to the high temperature and low humidity of the atmosphere.

Conversely, in all the northern Spanish regions and in the cold inner zone of the Iberica Peninsula, the summer tomato cultivations can be the most affected by Phytophthora.

SWITZERLAND:

The heaviest attack we had during the last years occurred in 1951. The losses in untreated plots in our Research Station were 8.8 percent by number of fruits, 5 percent by weight. This is a rare exception, indeed, as generally the losses are of no economic importance. Only some of the first-ripening tomatoes close to the soil usually are infected. This might be in connection with the heavy rainfalls we have in June and July. In the later summer and in the fall when precipitation diminishes there is no more danger of infection.

YUGOSLAVIA:

Generally speaking, damage caused by late blight on tomato plants is not important. In years of severe blight the amount of damage caused by this disease in some parts of our country is 50 to 60 percent and in years of moderate infection it is about 10 to 20 percent.

Control Measures; Effectiveness of These Measures

CYPRUS:

Owing to the sporadic appearance of the disease, no regular control measures are practised but copper sprays and dusts are applied when necessary.

DENMARK:

Spraying with Bordeaux mixture has good effectiveness.

ENGLAND:

Frequent spraying during the summer with officially approved copper fungicides, when efficiently applied and suitably timed, gives very good control. This is a routine practice on most well-managed outdoor holdings. As a general rule it is sufficient to begin spraying in early August, 3-4 weeks later than potato spraying for the same areas.

FINLAND:

According to the literature from abroad, spraying with Bordeaux mixture or zineb is recommended as an aid in controlling late blight.

GERMANY:

The disease may be readily controlled by means of copper sprays. Two or, in cases of severe attack, more than two applications of copper sprays (for example, 0.3-0.5% copper-oxychloride with a 50% copper content, or red-copper (copper-oxydul) preparations) are recommended, beginning the middle or end of June, depending on weather conditions, and continued at intervals of 3-4 weeks. If the spray is not washed off by frequent rains, as is often the case, as for example this year, the results are usually satisfactory.

IRELAND: See under Northern Ireland or Republic of Ireland.

ITALY:

Bordeaux mixture, 1-1-100, is almost universally employed, with very good results against late blight. In the search for a more efficient, polivalent treatment, the use of ziram (and more of zineb) is increasing.

JERSEY (Isle of):

Blight in Jersey has been severe in the past but has declined during the last ten years owing to spraying; 10 to 12 applications are required each season.

MALTA:

Spraying with half-strength Bordeaux mixture.

NETHERLANDS:

Copper is recommended. It greatly diminishes losses.

NORTHERN IRELAND:

It has not been necessary to advocate control measures, but spraying with a copper fungicide would undoubtedly prove effective.

NORWAY:

Two to three applications of Bordeaux mixture or a fixed copper or zineb usually control the disease on tomato.

REPUBLIC OF IRELAND:

Spraying with Bordeaux mixture or other copper compounds. Little information on the effectiveness of these sprays owing to the very limited outside cultivation of tomatoes.

SCOTLAND:

On the rare occasions when control measures have been asked for, spraying with Bordeaux mixture has been advised and used with, we believe, success.

SWEDEN:

For control the same measures used for the control of potato blight are recommended. The growers of outdoor tomatoes are not yet very acquainted with this disease and so mostly do not do anything about it.

SWITZERLAND:

We obtained the best control with captan (Orthocide) 0.5% and Bordeaux mixture 1%. Dichloro-naphthoquinone and zineb were less effective and TMTD was insufficient.

YUGOSLAVIA:

We are advising application of Bordeaux mixture. Its use gives good results if this application has been done in due time. The control measures against this disease are applied only in certain parts of our country.

Strains; Varietal Resistance

CYPRUS:

Cyprus has no information available recording the existence of strains.

DENMARK:

We do not have anything on the existence and numbers of strains of Phytophthora infestans on tomatoes. This year there were tested different samples of potato leaves from different parts of Denmark. Three potato strains were found this year: 0, 1, and 4 according to the International System.

ENGLAND:

We have no definite information about strains of the fungus occurring on tomato (the strains found on potatoes are fairly well-known); nor have we any evidence on varietal resistance in tomato.

FINLAND:

Strains of Phytophthora on tomato have not been studied; nor the varietal resistance of tomato.

GERMANY:

So far as we know, tomato is especially susceptible to a form of Phytophthora limited to this host; however, "potato-races" can also be transmitted to tomato. Further specialization of "tomato-races" or appreciable differences in susceptibility of various tomato varieties are unknown to us.

IRELAND: See under Northern Ireland or Republic of Ireland.

ITALY:

The existence of a number of strains of Phytophthora infestans in Italy has been ascertained.

JERSEY (Isle of):

With reference to the crossing of the disease from tomato to potato, there is evidence for the existence of varietal strains of the fungus. [Cf. Small, T. 1988. The relation between potato blight and tomato blight. Ann. appl. Biol. 25: 271-276; and, Small, T. 1952. Tomatoes in Jersey. Jour. Ministry Agric. 58: 576-579.]

MALTA:

No evidence of varietal strains.

NETHERLANDS:

Miss de Bruyn succeeded in proving that the tomato strain of Phytophthora can be obtained by passage of the "common" potato strain through tomatoes.

There is no evidence of physiologic races within the tomato Phytophthora. Data on host resistance is not available owing to the unimportance of outdoor tomatoes.

NORTHERN IRELAND:

Until recently we have not investigated the number of strains of Phytophthora infestans occurring in Northern Ireland although this is a problem now receiving attention. We know that most of the common strains of the fungus which cause potato blight are present but so far we we have no information as to the exact status of the strains responsible for late blight of tomato and we are, therefore, unable to provide information on the varietal host relationship.

We also have no information as to varietal host resistance.

NORWAY:

Studies on strains of Phytophthora infestans in Norway are now in progress, but so far no data are available.

Varietal differences in host resistance was reported only once. [Cf. Ramsfjell in Aktuelt i grønsakdyrkinga, Oslo, 1952.]

REPUBLIC OF IRELAND:

There is no information on the existence of different strains of Phytophthora infestans, nor on varietal resistance.

SCOTLAND:

Phytophthora infestans exists in Scotland in five strains. No information exists as to varietal differences as regards tomato crops in Scotland.

SWITZERLAND:

It is obvious that varietal resistance exists but no experimental work has yet been done in our country.

YUGOSLAVIA:

We have no information on the existence and number of strains of Phytophthora infestans on tomatoes for we have not worked on this problem in Yugoslavia.

We have no data, also, on varietal host resistance.

Bibliography:

* -- Indicates references furnished by cooperators.
All others were taken from available literature.

Allard, H. A. 1947. Early reports of destructive attacks of late blight on tomatoes in England. Plant Dis. Reptr. 31: 231.
Refers to The Gardeners' Chronicle 10 (N.S.), Sept. 14, 1878, p. 343 in re a great epidemic occurring in England in 1878; ibid. August 24, 1878 and also p. 537, Oct. 26, 1878.

*Anonymous. 1952. Plant Pathology Division. Res. & Exp. Rec., Minist. Agric. Northern Ireland, 1951. pp. 111-116.

Appel, O. 1933. Tomatenkrankheiten. Deutsche Landw. Presse 60: 247.

Arnaud, G. and J. Barthelet. 1935. Les maladies plantes horticoles et leur traitement en France. Compt. Rend. Congr. Intern. Hort. 11, Sec. 5, Theme 9: 1-5.

*Ascaratein, ? . 1893. "Insectos y Criptogamas que invaden los cultivos en España." Madrid.

Bewley, W. F. 1923. Diseases of glass-house plants. 208 pp.

_____. 1934. Tomatoes: cultivation, diseases, and pests. Minist. Agric. & Fisheries 77. 71 pp.

Black, W. 1952. A genetical basis for the classification of strains of Phytophthora infestans. Proc. Roy. Soc. Edinb., B, 65: 36-51.

_____ and A. Mezzetti. 1950. Biotipi di Phytophthora infestans de By. in Italia. Bol. Staz. Patol. Veg. 6: 123-127. (1948).

_____, C. Mastenbroek, W. R. Mills, and L. C. Peterson. 1953. A proposal for an international nomenclature of races of Phytophthora infestans and of genes controlling immunity in Solanum demissum derivatives. Euphytica 2: 173-179.

Bond, T. E. T. 1936. Phytophthora infestans (Mont.) de Bary and Cladosporium fulvum Cooke on varieties of tomato and potato and on grafted solanaceous plants. Ann. appl. Biol. 23: 11-29.

Bondartseva, A. S. 1906. [Vegetable parasites of cultivated and wild plants, collected in the government of Kursk during 1901, 1903-1905]. Acti Horti Petropolitani 26: 1-52.

Bondartseva-Monteverde, V. N. 1926. [Phytophthora infestans on tomato]. Bolezni Rastenii 15: 1-27. (German summary).

_____. 1927. [Some complementary observations on Phytophthora infestans (Mont.) de By. on tomatoes]. Morbi Plantarum, Leningrad 16: 76-81. (German summary.) Re strains.

Cooke, M. C. 1902-03. Pests of the flower and vegetable garden. Jour. Roy. Hort. Soc. 27: 1-45; 369-406; 801-831.

Croxall, H. E. 1943. The control of blight (Phytophthora infestans) on outdoor tomatoes. Bristol Agr. & Hort. Res. Sta. Annual Rept.: 95-99.

Danon, Mojse. 1951. Stetnici i bolesti u NR Hrvatskoj 1950. [Pests and diseases in Croatia for the year 1950]. Biljna Proizvodnja 4: 275-286.

Darcy, C. 1936. Le mildiou de la pomme de terre et de la tomate. Jardinage 24: 28-30.

*de Bruyn, Helena L. 1951. Pathogenic differentiation in Phytophthora infestans (Mont.) de Bary. Phytopathologische Zeitschrift 18: 339-359.

*Dennis, R. W. G. and C. E. Foister. 1942. List of diseases of economic plants. Trans. Brit. myc. Soc. 25: 266-306. (see p. 278).

Dufrénoy, Jean. 1923. Pulvérisations et poudrages des tomates contre les ataques du Phytophthora infestans. Rev. Bot. Appl. 3: 556-557.

Esmarch, F. 1925. Pilzkrankheiten an Tomaten. [Fungus diseases of tomatoes]. Die Kranke Pflanze 2: 149.

Gigante, R. 1936. Una nuova malattia del pomodoro. Bol. R. Staz. Patol. Veg. Roma, n.s. 16: 183-198.

Goidanich, G. 1936. Comportement parasitaire particulier de la Phytophthora infestans De By. [Abnormal parasitic behaviour of Phytophthora infestans De By.]. Bol. Sez. ital. Soc. int. Microbiol. 8: 165-168.

_____. 1936. Richerche sulle "Phytophthorae" del pomodoro. Bol. R. Staz. Patol. Veg. Roma 16: 175-182.

Green, D. E. and D. Ashworth. 1943. Blight of outdoor tomatoes -- spraying tests, 1942. Jour. roy. Hort. Soc. 68: 179-183.

_____, and C. T. Thomas. 1945. Note on blight of outdoor tomatoes. Jour. roy. Hort. Soc. 70: 211-214.

Gutsevich, S. A. 1944. [Diseases of potatoes and vegetable crops and control measures]. 73 pp. Leningrad, Press and Book Publishing Office. (Russian text.)

Hahmann, C. 1932. Abteilung für Pflanzenschutz. Jahresbericht für die Zeit vom 1 Januar bis 31 Dez. 1931. pp. 74-94. Institut für angewandte Botanik, Hamburg.

Ivakhnenko, A. N. 1938. [A study on tomato diseases]. Zapiski Khar 'Kovskogo Sel'skokhoziaistvennogo Inst. 1(2): 179-282.

*Jamalainen, E. A. 1953. Vuoden 1953 kasvitautitilanne. [Plant disease situation in 1953]. Ylipainos Maaseudun Tulevaisuuden Koetoiminta ja Käytäntö-liitteestä no.: 17/17. 12. 4 pp. (pamphlet).

*Jørstad, I. 1934. Sykdommer på tomater og agurkvekster. Meld. skadein. Plantes 1932-1933: 1-55.

Käsebier, A. 1926. Tomatiseemnete peitsimisekatsed formaliiniga, sublimaadigs ja "Uspuluniga". Mitt. Phytopath. Versuch. Univ. Tartu 1: 11-15.

Kearns, H. G. H. 1941. A method of spraying outdoor tomatoes. Bristol Agr. & Hort. Res. Sta. Annual Rept. 1941: 70-71.

Lepik, E. 1926. Fütopatoloogilised märkmed I. Moned tähelepanekud kultuurtaimede haigustest a. 1925. Mitt. Phytopath. Versuch. Univ. Tartu 1: 1-10.

Lind, Gustav. 1926. Försöksodling av tomater vid K. Landtbruksakademiens trädgårdsavdelning sommaren 1925. [Experiments with tomatoes at the Agricultural Academy during summer of 1925.]. Landtbr. -Akad. Handl. och Tidskr. 65: 268-270.

Ludwigs, Karl. 1927. Krankheiten und Feinde des Gemüsebaues im Frühjahr unter Berücksichtigung des Frühgemüsebaues unter Glas. Arb. Landwirtschaftkam. Prov. Brandenb. 58: 50-64.

Marchal, Él. et Ém. 1921. Contribution a l'étude des champignons fructicoles de Belgique. Bulletin de la Société Royale de Botanique de Belgique 54: 109-139.

Maury, M. 1931. Florule cryptogamique de la Champagne crayeuse (Myxomycetes, Siphomycetes, Uredinées et Ustilaginées). Bull. Soc. Mycol. France 47: 157-199.

Mijuskovic, M. 1950. [Diseases of plants observed in Montenegro in 1949]. Zastita Bilja 1: 94-105.

Minkiewicz, St. 1941. Chief diseases and pests observed in 1940. In Discoveries and current events (under Poland). Intern. Bull. Plant Protect. 15: 4M-6M.

Moesz, G. 1938. Fungi Hungariae. II. Archimycetes et Phycomycetes. [Fungi of Hungary. II. Archimycetes and Phycomycetes]. Ann. hist.-nat. Mus. hung. 31: 58-109. (Hungarian and German.)

Moore, W. C. 1947. Report on fungus, bacterial and other diseases of crops in England and Wales for the years 1933-1942. Minist.Agric. & Fisheries Bull. No. 126.

_____. 1948. Report on fungus, bacterial and other diseases of crops in England and Wales for the years 1943 - 1946. Minist. Agric. & Fisheries Bull. No. 139.

*_____. 1949. The incidence of plant diseases in England and Wales. Sci. Hort. 9: 95-95.

Nattrass, R. M. 1932. Late blight of potatoes. Cyprus Agric.Jour. 27: 65-68.

Naumann-Pillnitz, U. 1925. Schädigungen der Tomatenpflanzen. Die Kranke Pflanze 2: 195-198.

Osnitskaia, E. A. 1948. [Measures for the control of diseases in tomatoes]. Sad i Ogorod 1948 (3): 53-56.

Pethybridge, G. H. 1929. Report on the occurrence of fungus, bacterial and allied diseases of crops in England and Wales for the years 1925, 1926 and 1927. Minist. Agric. & Fisheries Misc. Publ. 70: 1-72.

Riakhovskii, N. A. 1935. [Determination of the injuriousness of tomato diseases, and development of methods for their control]. Zashchita Rastenii 3: 88-91.

Riehm, A. and M. Schwartz. 1935. Pflanzenschutz. Vol. 2, Ed. 9: 1-318.

Röder, K. 1935. Untersuchungen über die Phytophthorakrankheit (Phytophthora infestans) der Tomate. Unter besonderer Berücksichtigung der biologischen Spezialisation des Erregers. [Studies on the Phytophthora disease (Phytophthora infestans) of the tomato, with particular reference to biological specialization in the causal organism]. Phytopath. Zeitschr. 8: 589-614.

Roumeguere, C. 1882. Fungi Galli exsiccati. Revue Mycologique 4: 150-159.

Salmon, E. S. and H. Wormald. 1921. The potato blight fungus on tomatoes under glass in April. Gard. Chron. 69: 311-312.

Sarejanni, J. A. 1936. Liste II. Des maladies des plantes cultivées et autres de la Grèce. Ann. Inst. Phytopath. Benaki 2: 8-12.

Săvulescu, T., et al. 1943. Starea fitosanitară in România in anul 1940-1941. Inst. Cercetări Agron. Roman. Mon. no. 82. (Also in French.)

Schoevers, T. A. C. 1922. Ziekten en Beschadigingen van Tomaten. [Diseases and injuries of tomatoes]. Tijdschr. over Plantenziekten 28: 67-93.

*Schøyen, W. M. 1899. In Beretning om Skadeinsekter og Plantesygdomme in 1898. Printed in Kristiania (Oslo).

Shembel', S. Iu. 1930. [Diseases of tomatoes in Astrakhan District]. Zaspiski Astrakhanskoi Stantsii Zashchity Rastenii ot Vreditelei 2(4): 32-34.

Sibilia, C. 1929. Contributo alla flora micologica del territorio de Anagni. Ann. de Bot. 18: 253-300.

Simpson, D. 1926. Sprays against blight in potatoes and tomatoes. States' Exper. Farm, Jersey. Leaflet, 4 pp.

Small, T. 1936. Diseases of outdoor-grown tomatoes in Jersey. Jour. Minist. Agric. 43: 117-124.

_____. 1938. The relation between potato blight and tomato blight. Ann. appl. Biol. 25: 271-276.

Small, T. 1952. Tomatoes in Jersey. Jour. Minist. Agric. 58: 576-579.
*Solla, R. F. 1880. Note di Fitopatologia. Firenze.
*Uruijo, ? . ?. Tratamiento del "mildio" de la patata y el tomate. Estacion de Fitopatologia Agricola de La Coruña y Seccion Agronomica de Pontevedra.
Voglino, P. 1923. I funghi piu dannosi alle piante coltivate osservati nella Provincia di Torino e regioni vicine nel 1921. [The fungi most injurious to cultivated plants observed in the province of Turin and the vicinity in 1921]. Ann. R. Acad. Agric. Torino 65: 53-64.
Volk, A. 1931. Einflüsse des Bodens, der Luft und des Lichtes auf die Empfänglichkeit der Pflanzen für Krankheiten. Phytopath. Zeit. 3: 1-88.
von Ruhmwerth, R. Rapaics. 1914. Phytopathologische Beobachtungen in Debrecen (Ungarn). Zeitschr. für Pflanzenkrankheiten 24: 211-218.
Wain, R. L. and E. H. Wilkinson. 1942. A preliminary trial of new copper fungicides on outdoor tomatoes. Bristol Agr. & Hort. Res. Sta. Annual Rept. 1942: 56-58.
Weber, Anna. 1922. Tomatsygdomme. Aarbog for Gartneri 4: 13-61.
Williams, P. H. 1941. Important diseases of glasshouse plants. Fruit-grower (London) 91: 465-467.
Wiltshire, S. P. 1915. A note on Phytophthora infestans (de Bary) occurring on tomatoes. Agric. & Hort. Res. Sta. Annual Rept. p. 92-93.
Wollenweber, H. W. 1932. Tomatenkrankheiten und ihre Abwehr. Biol. Reichs. Land- und Fortstw. 118/119: 1-6.

AFRICA

First Report

ALGERIA:
No record of first appearance.

ANGOLA:
Phytophthora infestans does not exist in the Province of Angola; and has not been observed. Very rarely do members of the Peronosporaceae occur in Angola.

BELGIAN CONGO:
No record of late blight on tomato.

BRITISH CAMEROONS:
Phytophthora infestans was found on leaves of tomato in 1953.

EGYPT:
Late blight was reported on tomatoes for the first time in Egypt in December, 1948.

FRENCH SOMALILAND:
No record of the disease.

FRENCH WEST AFRICA:
Phytophthora infestans has never been found up to the present time in French West Africa -- Mauritania, Senegal, Black Soudan, High Volta, Guinea, Ivory Coast, Dahomey as well as Togo.

The ordinary tomato is not cultivated except around the large centers for the revictualing of Europeans; the African tomato (Lycopersicon cerasiforme), cultivated at the end of the rainy season by the Africans, is resistant to cryptogamic infections.

GOLD COAST:
No record of Phytophthora infestans being observed on tomato in the Gold Coast.

KENYA:
Late blight was first recorded in Kenya in 1941 and attacked both potatoes and tomatoes.

LIBERIA:
Tomatoes are often severely ravaged by wilt, whether Phytophthora infestans-induced or not is not known at this time. The impression is that the wilt-causing trouble is caused by a soil-borne organism and is probably bacterial in nature.

LIBYA:
Think it has been present in Libya for many years.

MADAGASCAR:
No late blight has ever been seen in Madagascar, neither on tomato nor on potato, nor any other host of Phytophthora infestans.

Tomatoes are grown everywhere in our Island, but only on a small scale in gardens.

MAURITIUS:
In 1930; but probably existed long before.

MOÇAMBIQUE:
The first record was in 1951.

MOROCCO:

The first notice of Phytophthora infestans on tomato was in 1931. It probably existed in the country for an exceedingly long time, but the absence of our specialized service until 1927 does not permit us to furnish the information more precisely.

NIGERIA:

Phytophthora infestans not noted on tomato in the vicinity of Ibadan, Western Province of Nigeria.

NORTHERN RHODESIA:

No late blight of either tomato or potato has been encountered, due entirely to absence of favorable weather conditions.

NYASALAND:

No record of Phytophthora infestans on tomato.

RÉUNION:

It is not possible to indicate at which date late blight was found for the first time in Réunion.

G. Bourriquet, at the time of carrying out a mission to Réunion in October, 1932, did not find Phytophthora infestans on tomato but only on potato [cf. Bourriquet, G. Rapport phytopathologique sur un voyage d'étude effectué à la Réunion en Octobre 1932. Revue Agricole de l'Ile de la Réunion, Janvier 1934].

SIERRA LEONE:

Phytophthora infestans has not yet been recorded in Sierra Leone on tomato or on any other host plant.

SOMALILAND PROTECTORATE:

No record of first observation.

SOUTHERN RHODESIA:

Typical late blight on tomato has not yet been recorded in Southern Rhodesia, apart from two or three isolated instances of tomato fruits being attacked by Phytophthora infestans when growing immediately alongside heavily infected potato plants.

No tomato foliage or stem infections by late blight have been seen or reported.

SUDAN:

Phytophthora infestans has not been recorded on tomato in the Sudan although there is a record of it on potato in the extreme southern Sudan where the annual rainfall is high. Not of economic importance since potatoes are only occasionally cultivated.

TANGANYIKA TERRITORY:

First recorded in Northern Province, October, 1944.

TANGIER:

No record of first appearance.

TUNISIA:

No tomato growers have ever made a statement to us (Service Botanique et Agronomique, Ariana) of the notorious havoc produced by Phytophthora infestans; the Service itself has rarely observed attacks of mildew.

UGANDA:

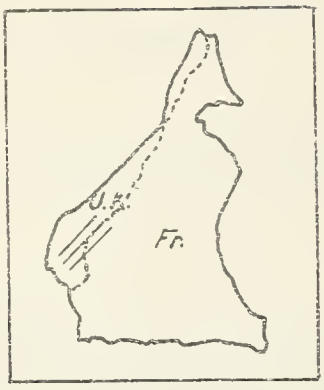
Never recorded for Uganda.

UNION OF SOUTH AFRICA:

There was one report in 1922. The disease then apparently disappeared and was not reported again until 1952.

Distribution

BRITISH CAMEROONS:

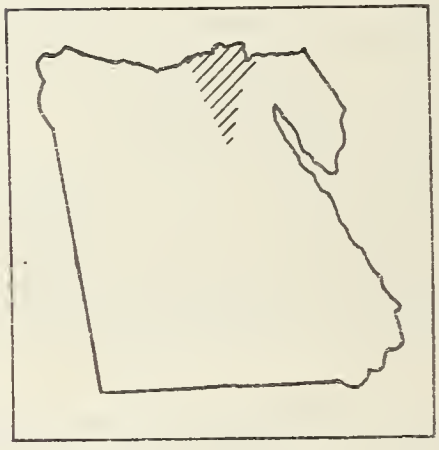


Cameroons
(Van der Grinten's Proj.
632 miles to the inch)

Spread across the Bamenda Province in 1952 on potato; occurred again in 1953 from whence [we] assume the spread to tomato leaves.

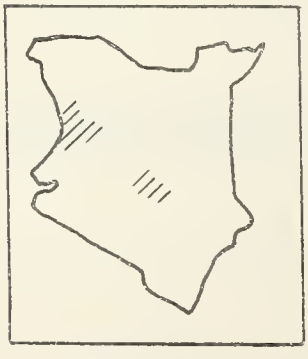
EGYPT:

The distribution of tomato late blight in Egypt follows the shape of an inverted triangle -- the two base points being Alexandria in the west and near Port Said in the east with the apex of the triangle at El 'Aival.



Egypt
(Van der Grinten's Proj.
395 miles to the inch)

KENYA:

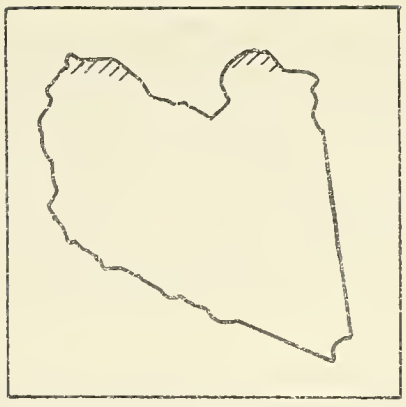


Kenya
(Van der Grinten's Proj.
395 miles to the inch)

The disease is now distributed wherever the crop is grown in the Kenya Highlands. We have had no definite records of it from the Coast. The Highlands are separated from the Coast by about 200 miles of semi-desert.

LIBYA:

We can consider, in general, the farms and oasis gardens of the coastal zone of Tripolitania to be affected by the disease (i.e. from Zuara to Misurata to a depth of an average of ten to fifteen miles from the coast). In Cyrenaica, similarly, it has been observed in the Benghasi, Derna and Barce areas.



Libya
(Van der Grinten's Proj.
632 miles to the inch)

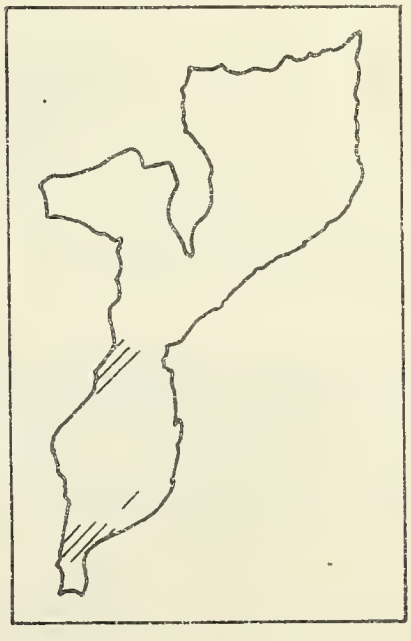
MAURITIUS:

Widespread throughout the Island, but more severe in upland areas.

Mauritius
(75 miles to the inch)

MOÇAMBIQUE:

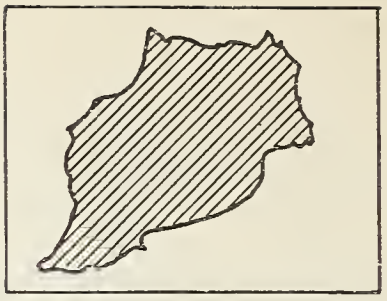
Phytophthora infestans has been reported on tomato from the following places in the Colony of Moçambique: Vila de Manica in the west; and from Umbeluzi, Namaacha, Catuane, Chongoene, Manhica, Infulene, and Catembe in the south.



Moçambique
(Van der Grinten's Proj.
395 miles to the inch)

MOROCCO:

Tomato mildew is distributed throughout all of Morocco. It is especially injurious near the shores of the Atlantic on account of the high moisture and the persistent fogs. Here, more than elsewhere, is found the more important cultivation of tomatoes (cultivation of the first crop for exportation).



Morocco
(Van der Grinten's Proj.
395 miles to the inch)

RÉUNION:

Réunion
(75 miles to the inch)

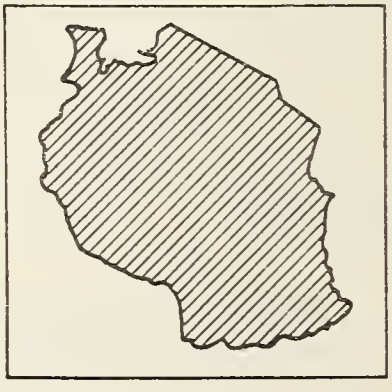
Late blight of tomato is seen very frequently in the region of the Plaine of Cafres, Tampon, and sometimes in La Montagne, in years of high humidity.

SOMALILAND PROTECTORATE:

Tomato blight has been observed in gardens developed around wells; this particularly during the two still, moist periods during the change of the Monsoons.

TANGANYIKA TERRITORY:

All over the Territory.



Tanganyika Territory
(Van der Grinten's Proj.
395 miles to the inch)

UNION OF SOUTH AFRICA:

It is now present wherever tomatoes are grown. Most families grow a few tomatoes in their vegetable gardens at home. [Cf. Wager, V. A. 1952. Late blight in tomatoes. Farming in South Africa 27: 333-334, 336.]

Union of South Africa
(Van der Grinten's Proj.
632 miles to the inch)

Spread; Environmental and Geographic Factors Involved; Potential Danger Spots

ALGERIA:

Phytophthora infestans is very common in the plantations of tomatoes in the different regions of Algeria where this plant is cultivated.

BRITISH CAMEROONS:

Phytophthora infestans appeared in the French Cameroons in 1951 on potato, possibly carried over from Europe in imported seed tubers; disease started near the French boundary and spread across the Bamenda Province in 1952. In 1953 the first crop was attacked and the fungus was also found on tomato.

EGYPT:

Observations indicate that Phytophthora infestans may be transmitted from one region to another through movement of infected tomato and potato plants; under favorable weather conditions epiphytotics may occur in the newly infested area.

In February, 1942, with a long period of rainfall, high humidity, and low temperatures, late blight appeared suddenly and destructively on tomatoes over a wide area of the Nile Delta, up to the Giza Province.

In Upper Egypt, beyond the Giza Province, weather conditions were not favorable and there were no commercial acreages of potatoes so that the disease did not appear on tomatoes in the winter crop.

KENYA:

It is assumed that spread is locally by wind and water droplets and by wind-borne sporangia over considerable distances. Apart from high temperature and desert conditions, there would appear to be no physical barrier influencing its spread or limiting its distribution.

The potential danger spots are the whole of the Highlands. The forest areas up to 800 to 900 feet carry perennial woody species of Solanum which are infected with Phytophthora infestans [cf. Nature 168: 85. 1951. New hosts of Phytophthora infestans in Kenya].

LIBYA:

The micro-climatic conditions have an important influence upon the development of the disease. High humidity and dews in irrigated farms encourage its development. Hot dry winds from inland reduce it.

MAURITIUS:

Disseminated by wind.

MOÇAMBIQUE:

In the lowveld tomatoes can only be grown in the winter as the summer temperatures are so high as to make cultivation of this vegetable nearly impossible.

In the winter the air is very moist, and during the night the mist and dew are very heavy. When the temperature falls very quickly, even only for one night, it is enough to aid the start of the disease.

The most dangerous spots are the valleys of the rivers where the mist forms during the night.

MOROCCO:

This disease, relatively secondary in Morocco, has not been studied scientifically in this country; the means of dispersion probably offers nothing in particular here; they are very similar to what you would find elsewhere.

In this country, in the main arid, the distribution of the disease is governed principally by the humidity of the air. That is why it is especially to be feared in the plantings on the Atlantic shore.

Serious epiphytotics are produced in the spring (February, March, April) and are dependent upon the not infrequent conjunction of favorable climatic factors: sufficient temperature, high atmospheric humidity, and rains. In exceptional cases the disease appears in the autumn.

RÉUNION:

Humidity and heat seem to be the factors which favor the development of the malady. Modes of carry over and of distribution of the spores are not known in Réunion.

SOMALILAND PROTECTORATE:

Believed to spread in the slow-moving moist air.

TANGANYIKA TERRITORY:

Rather guesswork, but as there are almost certainly potatoes growing (as crops or from ground-keepers) in one stage or another at all times of the year, tomatoes can become infected by wind-borne spores. There may be indigenous weed hosts but that is not proved in Tanganyika. Most of the records of blight are from the higher, cooler areas where tomatoes are usually grown.

TANGIER:

The disease appears slowly towards the 1st of July on plantings nearing the end of production. The disease is never very extensive because: (1) there are practically no rains from June 15 on; and (2) irrigation in the Zone of Tanger is very curtailed and is done by gravity and not by sprinkling (not any irrigation by spurt or by pipe).

TUNISIA:

It seems, in a general way, that Phytophthora infestans is not spread in Tunis in an episodical manner and that it does not constitute a subject of inquietude for the cultivators.

UNION OF SOUTH AFRICA:

It was presumably introduced in the first place in seed potatotes from Europe. (The disease has been present in our potatoes for very many years).

We assume that late blight is spread among the tomatoes by the wind. Since 1952 the disease has been present all the year round in South Africa. All areas in which tomatoes are growing at the time are, therefore, potential danger spots for other areas where tomatoes will be grown later.

Here I should mention that within the cooler regions there are several warmer or even subtropical areas as, for instance, on the northern side of the Magliesberg range of mountains near Pretoria. On the southern slopes tomatoes cannot be grown for four or five months of the year, whereas on the other side of the mountain frost is almost unknown and tomatoes are grown during the colder months.

Damage

ALGERIA:

The disease never reaches economic importance.

EGYPT:

In severe blight years the damage may reach 90 percent of the crop and can be estimated at 6 million pounds (the Egyptian pound = 2.87 dollars). In years of moderate infection 10 percent damage, estimated at 600,000 pounds, may occur.

LIBYA:

The damage caused by this disease is negligible because the attacks are generally limited and occur at a late stage. Some damage has been observed from August to November on fall crops but no attacks have been observed on spring crops.

KENYA:

In severe blight years Phytophthora infestans may bring about total destruction of the crop.

In years of moderate infection some crops may escape entirely according to location but if attacked at all, loss of fruit usually ensues.

MAURITIUS:

Severe losses on improved varieties.

MOÇAMBIQUE:

During the biggest outbreak of 1951 nearly all the plants were killed in some days' time and only 10 percent of the fruits could be marketed.

During 1952 and 1953 the disease caused only a small decrease in production because it was not so widely spread.

MOROCCO:

On the whole, damage is not important; the important attacks occur in the spring from February to April on plantings of the first crop, for export. Losses are never estimated.

RÉUNION:

Late blight sometimes produces havoc. It was very conspicuous in La Montagne in 1951; in 1953, the havoc was equally important in the region of the Plain of Cafres and of Tampon.

Attacks of Phytophthora infestans are especially severe during the summer months, November-December, January-February, corresponding to periods of high humidity and of heat.

In years of severe infection the crop, perhaps, is completely lost if the treatments are not practiced in time and repeated frequently. In years of moderate infection, losses are again rather evident.

Tomato cultivation is now limited to higher altitudes because of the presence of the insect, Antherigona excisa Thom, which causes enormous damage to crops in the coastal zone.

SOMALILAND PROTECTORATE:

Phytophthora infestans is nowhere really serious as vegetable growing is not of great importance in this country.

TANGANYIKA TERRITORY:

Complete destruction of plants, and no crop. The disease in both potato and tomato appears to be much more severe here than in Great Britain, for example.

More observations would be required to estimate losses in years of moderate infection. However, I think all years so far in this Territory have had more than moderate infection with corresponding losses of crop.

TANGIER:

Plantings lightly watered grow poorly but are almost always free from disease. Cf. also note under "Spread, etc."

UNION OF SOUTH AFRICA:

We have no figures on damage, but the disease commonly causes up to 80 percent loss in fields where no control measures are applied.

Control Measures; Effectiveness of These Measures

ALGERIA:

This disease is regularly fought with Bordeaux mixture and in recent years with zineb and captan. Cf. also note under "Damage".

EGYPT:

Dithane, Bordeaux mixture, tribasic copper sulphate, Fernide, Perenox, and Parzate were used and checked late blight of tomatoes. However, Dithane Z-78 and Bordeaux gave outstanding results.

KENYA:

Can be controlled by repeated applications of copper sprays. Dipping the seedlings at the time of transplanting is recommended.

LIBYA:

Owing to the weak development of the disease, the use of anti-cryptogamic products is not recommended. When necessary, use of cupric treatments (Bordeaux mixture or copper chloride) is recommended.

MAURITIUS:

Spraying with copper fungicide has been proved to be effective.

MOÇAMBIQUE:

In an experiment on spraying with fungicides, we found that Dithane Z-78 was the best product, compared with Blitox (copper oxychloride), Perenox (copper oxide), and Bordeaux mixture (0.5-0.5-100 and 1-1-100).

MOROCCO:

Organic fungicides have recently been put to trial. No significant differences have been found among them, nor between them and the copper fungicides. It has been proved, however, that the organic fungicides favor very vigorous growth, resulting in a very abundant crop. They are, therefore, recommended. But the practical results from treatments depend essentially on the timeliness and speed of application.

A warning service is necessary but does not exist.

REUNION:

Control measures are applications of Bordeaux mixture started 1 to 2 weeks after transplanting and continued until harvest.

It is difficult to estimate the extent to which control measures are used.

SOMALILAND PROTECTORATE:

No attempt has been made to control tomato late blight although it has been found here that weekly spraying with Perenox commencing after the formation of the first flower provides a measure of control. Cf. also note under "Damage".

TANGANYIKA TERRITORY:

We advocate copper sprays, applied from an early stage and whenever weather is conducive to blight. Several treatments are necessary, and their effectiveness has been demonstrated. We advise that enclosed damp conditions and close planting be avoided.

TANGIER:

No method of control is employed. The net cost of treatment with copper salts would burden the budget of Moroccan agriculturalists without producing appreciable yields.

UNION OF SOUTH AFRICA:

In the subtropical regions the disease is common in tomato seedbeds. Weekly sprayings with a copper-containing fungicide, or with zineb in areas where there is a tendency for the plants to suffer from a zinc deficiency, e.g. certain parts of the Transvaal Lowveld, are recommended. In the cooler regions the seedbeds are seldom attacked by disease.

After planting out, tomatoes usually remain healthy until about one third full-grown. Treatment against disease is, therefore, seldom necessary until about the time that the first fruits begin to form. Growers are then advised to spray weekly against Septoria leafspot and Early Blight which usually make their appearance at about this time. These weekly sprayings -- later changed to dustings as the plants become more dense -- are to a greater or less extent also effective against late blight which may make its appearance at any time, usually more severely as the season advances and the plants become bigger.

Because the copper fungicides are comparatively cheap, we recommend their use, notwithstanding their slight adverse affect on the plants. If necessary, we suggest the alternate use of the copper and zineb fungicides.

Strains; Varietal Resistance

EGYPT:

We think that late blight of tomatoes in Egypt is caused by two strains of Phytophthora infestans; the potato strain and the tomato strain.

No varietal host resistance has been studied up to now.

KENYA:

Five races of the fungus attacking potatoes have been identified by Dr. Black. They are Black's races A, C, D, G, H. Race E occurs in Tanganyika and probably also in Kenya.

We have no knowledge of any tomato varietal host resistance.

LIBYA:

We have no information about the number of strains of Phytophthora infestans here, or of varietal host resistance to it.

MAURITIUS:

No information is available on strains of Phytophthora infestans. The "cherry tomato", locally known as "pomme d'amour", is considerably more resistant than the improved varieties. This type of tomato, however, has an inferior flavour.

MOÇAMBIQUE:

We do not know yet the number of strains of Phytophthora infestans that occur in Moçambique but we want to study them in the future. In 1951 the variety "San Marzano" proved to be more resistant than the variety "Comet".

I think that in 1951 it was a new strain, imported in seed potatoes, that produced the big outbreak of the disease.

MOROCCO:

Nothing is known about the existence of races of Phytophthora infestans; no varieties of potato have been assayed.

TANGANYIKA TERRITORY:

The only strain actually identified from tomato in Tanganyika is I. From potato three strains have been identified: two of these are E found in 1948, and H found in 1954. Definite information is that E occurred in Dr. W. Black's "seedling" 914a (91) which was known to be resistant to A and C; H appeared in Dr. Black's 1792a (3).

TANGIER:

The question of races of Phytophthora in the Zone of Tanger has not been studied.

UNION OF SOUTH AFRICA:

On potatoes, races 0, 1, and 1, 2 in the new potato blight nomenclature (Cf. Euphytica 2: 2:173-178. 1953) have been demonstrated. On tomatoes only strain 0 has been demonstrated but no extensive survey has yet been made.

All varieties appear to be equally susceptible, but in one instance several rows (± 20) of San Marzano escaped infection when planted with several rows (±30) of (?)Pearson on either side.

Bibliography:

* - Indicates references furnished by cooperators.
All others were taken from available literature.

Anonymous. 1923. Blight in tomatoes. Jour. Dept. Agr. South Africa 6: 16.
Serious outbreak of blight in tomatoes reported from Stanger.

_____. 1939. Le mildiou de la pomme de terre et de la tomate, Phytophthora infestans (Mont.) de Bary. Memento No. 14, Défense des Végétaux, Rabat. 11 pp., 3rd edition. [Morocco.]

_____. 1952. Department of Agriculture, Kenya, Annual Report 1951. Under Research and specialist services. Vol. 1, 53 pp. See p. 19.
"was exceptionally severe throughout the Highlands... few tomato crops grown in the rains produced any return".

Bates, G. R. 1954. Report of the Chief Botanist and Plant Pathologist for the year ending 30th September, 1953. Rhodesia Agr. Jour. 51: 359-370.

Bouhelier, R. 1936. Traitements en hiver. (Spray applications in winter). Rev. maroc. Fruits Primeurs 6: 341-345.
"Phytophthora infestans which, while relatively rare on tomatoes,

causes much damage to potatoes".

*Bourriquet, G. 1934. Rapport phytopathologique sur un voyage d'étude effectué a la Réunion en Octobre 1932. Revue Agricole de l'Ile de la Réunion.

*de Carvalho, Tomas. 1951. Um novo e violento ataque de mildio (Phytophthora infestans de Bary). Gaz. Agric., Moçambique 3: 282-284.

Record of virulent outbreak of blight occurring in Moçambique on potatoes and tomatoes, constituting the first record of the pathogen on the latter host in the Colony. Infection symptoms on tomato are described; directions given for the control of the disease on both crops.

Doidge, E. M. 1924. A preliminary check list of plant diseases occurring in South Africa. Botanical Survey of South Africa, Memoir 6. pp. 1-56.

Dyer, R. A. 1951. Plant classification and control of crop diseases. Farming in South Africa 26: 488-490.

P. infestans very destructive on tomatoes and recorded for the first time in this area [? Lowveld].

*Guillemenet, R. 1954. Compte rendu d'un essai de protection des cultures de tomatoes contre le mildiou et l'alternariose au moyen de divers fongicides (campagne 1952-1953). Bull. de la Chambre d'Agriculture de Casablanca No. 276: 1-7.

Melchers, L. E. 1932. A check list of plant diseases and fungi occurring in Egypt. Trans. Kansas Acad. Sci. 34: 45-106.

Miller, R. W. R. 1945. Annual Report, Department of Agriculture, Tanganyika Territory, 1944. 9 pp.

Record of the appearance of blight on tomato in the Territory.

Nattrass, R. M. 1950. Annual report of the Senior Plant Pathologist, 1948. Rept. Dept. Agric., Kenya, 1948. pp. 95-98.

_____. 1950. Tomato blight in Kenya. E. Afr. agric. Jour. 15: 116-117.

_____. 1952. Annual report of the Senior Plant Pathologist, 1950. Rept. Dept. Agric., Kenya, 1950. Vol. II: 72-77.

_____, and Moira Ryan. 1951. New hosts of Phytophthora infestans in Kenya. Nature (London) 168: 85.

Russell, T. A. 1954. Potato blight in West Africa. Emp. Jour. exp. Agr. 22: 19-22.

Shepherd, E. F. S. 1926. Investigations on plant diseases. Botanical Division. Ann. Rept. Dept. Agric. Mauritius for the year 1925. pp. 9-11.

_____. 1934. Diseases of garden plants and fruit trees in Mauritius. Dept. Agr. Mauritius Bull. No. 43: 1-16.

Stockdale, F. A. 1914. Report Division of Phytopathology. Ann. Rept. Dept. Agric. Mauritius.

Wager, V. A. 1941. Descriptions of the South African Pythiaceae with records of their occurrence. Bothalia 4: 3-35.

_____. 1952. Late blight in tomatoes. Farming in South Africa 27: 333-334, 336.

*Wallace, G. B. and M. M. Wallace. 1945. Tomato blight. E. Afr. agric. Jour. 10: 181-182.

*Wiehe, P. O. 1953. The plant diseases of Nyasaland. Commonwealth Mycological Institute Mycological Paper No. 53. 39 pp.

ASIA

First Report

ADEN PROTECTORATE:

Late blight of tomato has not yet been noted or identified. The growing of tomatoes in the Protectorate is a fairly recent introduction.

CEYLON:

Phytophthora infestans recorded on fruit and leaves of tomato in 1906 from an estate in Lindula (5,000 feet); again recorded on leaves of tomato in 1941 from Balangoda (3,500 feet).

The tomato is grown in Ceylon more as a home garden crop and not on a commercial scale.

FEDERATION OF MALAYA:

No record of the first occurrence of Phytophthora infestans on tomato; first observed on potatoes in the highlands in 1934.

INDIA:

Mentioned in the literature [cf. Mem. Dep. Agric. India, Bot. Ser. VII, No. 3, 1915] that it worked havoc with the potato and tomato crops in Rangpur [Bengal = Pakistan now] in the year 1912-13.

Possibly ? present in the Nilgiris as early as last decade of nineteenth century.

IRAQ:

Phytophthora infestans on tomato has not been found (up to the present time) in Iraq.

ISRAEL:

Phytophthora infestans first recorded on tomatoes in Israel in May, 1927 at Tserifin (near Ramle, Lydda District) and at Nahalal (western plain of Esdraelon).

JORDAN:

No records exist of the first date of appearance; agreed by workers that it has been present for a long time.

MALAYA: See under Federation of Malaya.

PAKISTAN:

Phytophthora infestans does not appear to have been recorded so far officially.

It is possible that this disease may be present to some extent in hilly tracts like Murree Hills, Abbottabad, and Quetta and probably some places in East Bengal [for which latter see INDIA].

SYRIA:

Date of first appearance not known.

THAILAND:

Late blight of either tomato or potato is not present in Thailand. Neither crop is extensively grown.

TRANS-JORDAN: See under Jordan.

TURKEY:

Disease not yet found in Turkey; a Phytophthora sp., causing a fruit rot of tomato in Ismir (Smyrna) on the western coast of Asia Minor, has not been recorded from other parts of Turkey.

Distribution

CEYLON: See with India.

FEDERATION OF MALAYA:

Phytophthora infestans [on potato] is limited to the highlands (4,000 to 6,000 feet above sea level) where the total land under cultivation at present amounts to only a few hundred acres. Tomato is grown only on a small scale.

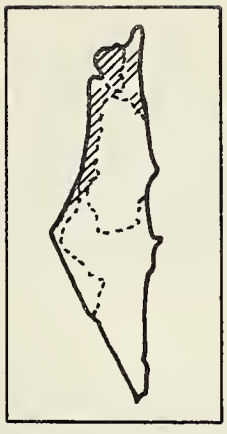
Malaya
(Van der Grinten's Proj
395 miles to the inch)

INDIA:

India
Pakistan
Kashmir
Ceylon
(Van der Grinten's Proj.
632 miles to the inch)

Phytophthora infestans recorded occurring in Pusa (Bihar), Rangpur (East Bengal = now Pakistan), Calcutta (West Bengal), Jalpaiguri and Jorhat (Assam), Himalayas and Khasi Hills (Assam). [Cf. Butler and Bisby. "Fungi of India")]

ISRAEL:



Israel
(Chamberlin Trimetric Proj.
118.4 miles to the inch)

Owing to the varying dates on which tomatoes are planted in different parts of Israel, the seasonal occurrence of Phytophthora blight varies with the areas involved. All summer crops are sown directly into the field in late April and May, or are planted out in May and June. On these crops blight appears sometimes in June. It is very unusual to find blight developing in spring or summer plantings after the beginning or middle of July.

Late blight of tomato is distributed in the Upper Jordan Valley, Beisan Valley, and the Eastern Vailey of Esdraelon, all at elevations below sea-level. It appears also in the Southern Coastal Plain area and in the Sharon and Emek Hefer districts.

Late blight has never been recorded on tomatoes in the Lower Galilee, the Western Galilee, the Haifa Bay area or the central Plain of Esdraelon; only very rarely on autumn plantings in the Western Valley of Esdraelon.

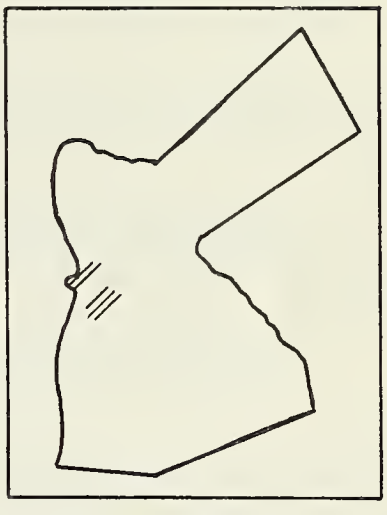
Blight has been variously recorded in the Huleh Basin but not in the Upper Galilee.

Blight has not so far been recorded in the large and climatically heterogeneous area of Hanegev, which is only now being brought under intensive cultivation and few observations have so far been made on tomatoes.

MALAYA: See under Federation of Malaya.

JORDAN:

The distribution of late blight in the Jordan districts is general, the variations being geographic and seasonal. In the Jordan Valley, below sea level, the winter months are the months of severe infection, and on the uplands, above sea level, it is June to September, inclusive, that are the serious tomato blight months. However, that does not mean that some late blight does not exist in the Jordan Valley during the summer nor that some does not exist on the uplands during the winter. But late blight follows the pattern of intensive culture of the tomato.



Jordan
(Chamberlin Trimetric Proj.
118.4 miles to the inch)

Jordan produces some 35,000 tons of tomatoes each year. Of the 35,000 tons some 40 percent are produced in the Hebron area some 800 to 1000 meters above sea level. About 30 percent are grown at the Ghor El Mazra, a fan shaped alluvial plain spreading out into the Dead Sea from Wadi Kerak and varying from 350 to 320 meters below sea level. The two areas are not competitors as the Ghor El Mazra is a winter production center and Hebron a summer area. The remaining 30 percent of production is rather evenly distributed over the rest of Jordan.

PAKISTAN: See with India

SYRIA:

Syria
(Van der Grinten's Proj.
395 miles to the inch)

Late blight of tomato occurs in Syria in the following places: in the southwestern part of the country around Damascus and near the eastern border of Palestine; in the northwestern part of the country along the shores of the Mediterranean Sea, along the banks of the Nahr El Asi, and around Aleppo. It is also found in the southern part near the border between Jordan and Iraq.

Spread; Environmental and Geographic Factors Involved; Potential Danger Spots

FEDERATION OF MALAYA:

The means of spread of Phytophthora infestans have not been studied in this country, nor its host range.

Late blight does not occur on lowland, probably because of the tropical climate and also possibly because no potatoes and very few tomatoes are grown there.

INDIA:

The disease has never been widespread and serious as the causal organism is mostly confined to the sub-Himalyan region and has been recorded only rarely in the plains even on potato, owing to unfavourable weather conditions.

The tomato as an agri-horticultural crop is a very recent development in India.

ISRAEL:

We have no information on the means of spread.

The environmental factors involved in the spread are several:

1. Rains. The date of appearance of blight in November-December in the various parts of the country appears to be related to the date of the first winter rains. No analysis of data to examine this relationship, or that of blight development and rainfall throughout winter and early spring, has ever been made here.

2. Morning Mists and Dew. The occurrence of Phytophthora infestans on spring and summer tomatoes from late April to July is regular and annually recurrent only in the Sharon and Emek Hefer districts of the Coastal Plain, where morning mists are frequent and dews heavy during these months.

3. Topography and Shade. The effect of these factors is particularly evident in the low valleys in winter. The Eastern Valley of Esdraelon is bordered by steep mountains on its south side. Tomatoes grown on these slopes (facing north) in winter are shaded by the mountains up to about 10 a.m. Such plots are always the first to be attacked and the hardest to protect of all plots in the Valley. Even trees or other tall objects may greatly speed up blight development in these valleys if they border plots on their southern side and thus provide extra shade during the morning hours of winter days. In one instance we saw that a row of trees of widely varying height which bordered a tomato field in the Beisan Valley on the southern side, was practically "photographed" in that field: opposite the tallest trees the blight penetrated deepest into the field, while opposite the lower trees the amount of blight was proportionately less.

4. Proximity of Blighted Potatoes. Potatoes in winter and spring suffer very severely from P. infestans in most districts of Israel, excluding Hanegev. The proximity of blighted potato fields has frequently been observed to be an important factor in the development of blight in tomato seedbeds (under glass frames) and in tomato fields. Sometimes only those rows of tomatoes that bordered on the potato field were infected.

5. Danger Spots. As particular danger spots we would designate the Upper Jordan Valley in December-March, and the Sharon and Emek Hefer districts of the Coastal Plain in May and June.

JORDAN:

The principal means of spread of late blight in Jordan would probably put the nursery seedbed first. At present we have no check on the merchants who sell seedling tomatoes and rarely can trace for certain the source of tomatoes after the farmer receives them.

The next important source of infection is the vicinity of the fields in which tomatoes are grown. Rotations are not controlled as yet and few growers are following them. We have a long way to go in getting farmers to accept rotation. They may have what to them are good reasons for not doing so but that does not help the problem. The smallness of the holdings makes rotation of little real value because, do what the farmer will, he cannot get his plants a safe distance from his neighbors.

Potato fields in the same vicinity also add to the source of inoculum. We need resistant varieties, too.

MALAYA: See under Federation of Malaya.

SYRIA:

Factors involved in the spread of this disease in Syria are not yet known.

Damage

FEDERATION OF MALAYA:

Tomatoes cannot be grown in the highlands without regular protection against late blight and there is no variation from year to year.

ISRAEL:

As the various parts of Israel differ so widely in climate and in the seasons of tomato planting, we cannot designate any given year as "severe", "moderate", or "light" for blight attack over the whole country. Thus, severe outbreaks of the disease in winter in the Jordan Valley may be followed by exceptionally light blight development in spring in the coastal plain.

The amount of damage caused by Phytophthora infestans on tomatoes can be assessed with any degree of accuracy only in respect of the winter crop grown in the Upper Jordan Valley, the Beisan Valley, and the Eastern Valley of Esdraelon. In these valleys protracted spells of rainy weather in November may induce blight attacks to coincide with the period of maximum host development. In these cases most of the fruit may be lost in the plots attacked at this stage. In the Upper Jordan Valley in 1951-52 the loss of marketable fruit reached about 25 percent of the total crop which equals a financial loss of about half a million Israel Pounds or 300,000 U. S. dollars.

A general estimate of blight damage in other parts of Israel cannot be made, because in most cases blight appearance is sporadic. Even in the Sharon and Emek Hefer districts of the coastal plain, where the disease regularly appears on the spring or summer crop, the amount of damage varies within extremely wide limits, depending on microclimatic factors, the date of disease appearance in relation to planting date, the proximity of blighted potatoes, and the timing and nature of chemical treatments primarily directed against other diseases.

JORDAN:

The amount of damage caused in a severe year will never be as great as it would be in sections of the U. S. of the same size because of the difference in climate here. Practically one-half of the tomatoes are grown below sea level and thus the chances of an epiphytotic spreading, as it would along the Atlantic Seaboard, are greatly reduced.

MALAYA: See under Federation of Malaya.

SYRIA:

The damage caused by late blight on tomatoes is 50 to 70 percent in severe blight years; 10 to 20 percent in years of moderate infection.

Control Measures; Effectiveness of These Measures

FEDERATION OF MALAYA:

Spraying with Bordeaux mixture or Perenox. Under regular spraying schedule tomatoes can be grown relatively free from late blight.

ISRAEL:

In the lower valleys tomato growers are advised not to plant where tall objects or mountains to the south or southeast of the field will shade the latter excessively.

In the coastal plain, where the prevailing wind direction is from the sea (west), growers are advised to avoid the proximity of their spring and summer tomatoes to spring potatoes, as these suffer from blight earlier and more extensively than tomatoes. If this is impracticable, as is the case in many small-holders' settlements, growers are directed to plant their tomatoes to the west, and in no case to the east, of their potatoes to avoid direct transfer of inoculum from the blight potatoes to the young tomatoes by the moist west wind. Occasional east winds are less dangerous in this respect because they are dry.

The control measures generally recommended are zineb sprays (e.g. Dithane Z-78 at 0.2% concentration) for seed-beds and young crops, and either zineb or cuprous oxide sprays (e.g. Perenox 0.25%) for the maturing crop. Phygon XL (at 0.2%) has also given very good results in trials but has not yet been generally introduced. Dusting with zineb or copper dusts is not very satisfactory and is advised only where (a) irrigation is by furrows and not by overhead sprinklers, and (b) no spray can be applied.

The efficacy of chemical control measures depends largely on (a) the weather, (b) the stage of plant development at disease outbreak, and (c) the timing of the control operation. In illustration we may mention the blight outbreak in the Upper Jordan Valley in November-December 1951 -- it was then established that plots planted early (late August, early September) were less affected than those planted later (late September, early October). Under weather conditions extremely favourable to the disease, timely spraying saved most of the earlier plantings, but the later plots were in many cases total losses. In other parts of the country, where the weather is rarely quite so favourable to tomato blight, spraying may be considered generally effective.

JORDAN:

Security measures are recommended as follows: (a) rotation and sanitation; (b) spray with copper fungicides; (c) check seedlings for disease before purchasing them.

MALAYA: See under Federation of Malaya.

SYRIA:

Recommendations for control include: (a) dusting with sulfur at 15-day intervals from the flowering period; (b) use of copper compounds.

Strains; Varietal Resistance

FEDERATION OF MALAYA:

We do not have any information on races of Phytophthora infestans, nor on varietal resistance. Potatoes and tomatoes are not grown thus far in Malaya on any appreciable scale. With only one plant pathologist at a time in this country, investigations of this nature could not be undertaken.

INDIA:

Recent inquiries at Simla (about 7,000 feet altitude) shows that Phytophthora infestans does not usually occur on tomatoes in the Simla Hills although it frequently attacks potatoes and at times very severely. Even during such an epidemic no infection of the tomato plots growing in close proximity of potato fields severely affected with late blight was observed at the Potato Research Substation at Kufri (Simla Hills, altitude 10,000 feet).

ISRAEL:

Studies on strains of Phytophthora infestans have been commenced in 1953. It is too early to draw conclusions from this work. However, it may be stated that so far inoculum taken from potatoes has always infected tomatoes and vice versa. We have not observed any major differences in their reaction to blight between the tomato varieties grown here. The principal variety is "Marmande". "Chatham" is also grown extensively. Both are highly susceptible.

JORDAN:

At present we have no information on the races of Phytophthora infestans in Jordan on tomatoes. Drs. William Black of Edinburgh and C. Mastenbroek of Holland have been kind enough to identify isolations of P. infestans from potato. It is clear that we have two races, i. e. Race 0 and Race 4, based on the International Classification. This knowledge is giving us an opportunity to select potatoes on the basis of the known races of late blight. We hope to be able to do likewise with tomato races also.

MALAYA: See under Federation of Malaya.

Bibliography:

* - Indicates references furnished by cooperators.
All others were taken from available literature.

Belgrave, W. N. C. 1939. V. Division of Plant Pathology. Ann. Rept. Dept. Agr. Malaya, 1938. p. 69-73.

Bremer, H. 1953. Phytopathologische Probleme an Kulturpflanzen im Trockenklima. [Phytopathological problems in cultivated plants grown in a dry climate]. Biol. Zentralanstalt f. Land- u. Forstw. Mitt. (Berlin) 75: 79-81. [German text].

*_____, H. Ismen, G. Karel, H. Özkan, and M. Özkan. 1947. Beiträge zur Kenntnis der parasitischen Pilze der Türkei. I. [Contributions to knowledge of the parasitic fungi of Turkey. I.]. Rev. Fac. Sci. Univ. Istanbul, Ser. B, XII, 2, pp. 122-172. [Turkish summary].

*Butler, E. J. 1903. Potato diseases of India. Agricultural Ledger 10: 87-124.

_____. 1917. The dissemination of parasitic fungi and international legisla- Mem. Dept. Agr. India, Bot. Ser., 9: 1-73. (See p. 44-46).

*_____, and G. R. Bisby. 1931. The fungi of India. Imper. Council of Agric. Res. Scient. Monograph 1. xviii + 237 pp.

Chorin, M. and J. Palti. 1951. Leaf, stem and fruit diseases of vegetables of the Solanaceae in Israel. viii + 63 pp. 'Sifriat Hassadeh', Tel-Aviv. [Hebrew text, English summary].

*Dastur, J. F. 1915. Potato blight (Phytophthora infestans) on potatoes and tomatoes in India. Mem. Dept. Agric. India, Bot. Ser. 7. 14 pp.

_____. 1917. Conditions influencing the distribution of potato blight in India. Agric. Jour. India, Special Indian Science Congress Number, 1917. pp. 90-96.

Ideta, Arata. 1909. Nogakko-yo Shokubutsu Byorigaku. Textbook of Vegetable Pathology .

*Jagoe, R. B. 1952. Notes on current investigations, October to December, 1951. Malay. Agric. Jour. 35: 36-52.

*Karthaus, J. P., and T. H. Thung. 1941. Het verenten van tomaten op voor slijmziekte resistente onderstammen. Natuurwetenschappelijk Tijdschrift voor Nederlandsch Indië 101: 266-270.

Krispin, S. 1943. The Phytophthora diseases of potatoes and tomatoes. Hassadeh (Tel-Aviv) 23: 199-201.

Lavroff, N. N. 1932. Key for the identification of vegetable parasites of cultivated and wild useful plants of Siberia. Part I. Field, kitchen garden, cucurbitaceous, and technically useful crops. 140 pp. Tomsk.

Miyake, Ichiro. 1912. Studies in Chinese Fungi. The Botanical Mag. 26: 51-66.

Mitra, S. K. 1935. Appendix I, Ann. Rept. of the Economic Botanist, IV., Mycology. Ann. Rept. Dept. Agr. Assam 1933-34: 50-51.

Nuttonson, M. Y. 1952. Ecological crop geography and field practices of the Ryukyu Islands, natural vegetation of the Ryukyus, and agro-climatic analogues in the Northern Hemisphere. Amer. Inst. Crop Ecology. 106 pp.

Petch, T. 1922. A preliminary list of the diseases of cultivated plants in Ceylon. Bull. 52, Dept. Agric. Ceylon.

Reichert, I., J. Palti, and G. Minz. 1944. Field trials for the control of tomato leaf diseases. Palestine Jour. Bot., R. Ser., 4: 117-141.

*_____, _____ , and S. Moeller. 1947. Spraying and dusting trials for tomato disease control. Palestine Jour. Bot., R. Ser., 6: 188-200.

Sawada, K. ?1931. List of fungi found in Formosa. Govt. Res. Inst., Taihoku, Formosa. 103 pp.

Shirai, M. and K. Hara. 1927. A list of Japanese fungi hitherto known. 3rd rev. and enlarged ed. vi + 504 pp., Shizuoka, Japan.

Tai, F. L. 1936. A list of fungi hitherto known from China. Sci. Rep. Tsing-Hua Univ., Ser. B, 11, 2: 137-167.

Thompson, A. 1935. The Mycological Division. Rept. Dept. Agric. F. M. S., 1934. pp. 61-63.

_____. 1935. Diseases of the potato plant at Cameron Highlands. Malay. Agric. Jour. 23: 410-420.

_____. 1936. The Division of Mycology. Rept. Dept. Agric. Malaya, 1935. pp. 64-66.

_____. 1939. Notes on plant diseases in 1937-1938. Malay. Agric. Jour. 27: 86-98.

AUSTRALASIA AND PACIFIC OCEAN AREAS
(excepting U. S. territory or possession)

First Report

AUSTRALIA:

New South Wales: In 1910.

Northern Territory: No record.

Queensland: Found in a Brisbane suburb, May 19, 1909.

South Australia: Phytophthora infestans on tomato has never been recorded.

Victoria: In 1911; found previously on tomato fruits imported from the States of New South Wales and Queensland in 1910.

Western Australia: Tomato late blight has not been recorded in Western Australia.

NEW ZEALAND:

First official record in 1905.

TASMANIA:

First reported in the 1952-53 season; probably occurred before then.

BRUNEI:

There are no reliable records of the occurrence of late blight in Brunei.

Cultivation of tomatoes in Brunei is at present very poorly developed; in fact, nothing more than a back garden hobby.

FIJI:

Wilt disease of tomatoes has been reported without naming the causal organism.

INDONESIA:

No record of the first report. Confirmed evidence of the presence of the disease taken from Karthaus, P. J. and Thung, T. H. 1941. The grafting of tomatoes on undercuttings resistant to the slime disease. Natuurwetenschappelijk Tijdschrift voor Nederlandsch Indië, dl. 101: 267. (In Dutch).

NEW GUINEA: See under Territory of Papua and New Guinea.

NORTH BORNEO:

Information not available for North Borneo.

"..... the situation with regard to the occurrence of this pathogen will be similar to that obtaining in Malaya..." [q.v. under ASIA]

PAPUA:

See under Territory of Papua and New Guinea.

PHILIPPINE ISLANDS:

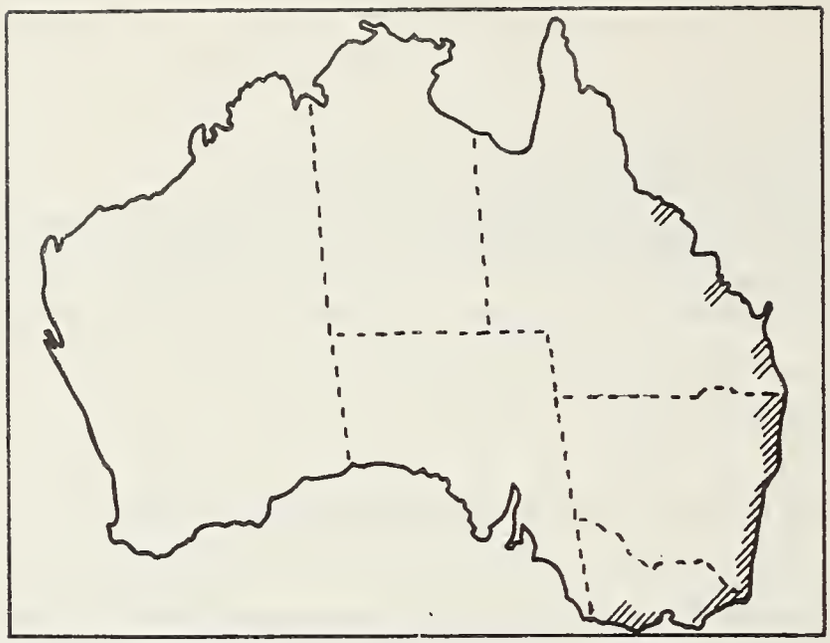
Tomato late blight observed since 1929 (Mountain Province) although it is believed to have been present some years prior to this date.

TERRITORY OF PAPUA AND NEW GUINEA:

Phytophthora infestans has not yet been recorded on tomatoes in this Territory; even in the Highlands, where conditions would appear to be suitable for development of blight, P. infestans has not been observed on either tomatoes or potatoes.

Distribution

AUSTRALIA:



Australia
(Van der Grinten's Proj.
632 miles to the inch)

New South Wales: Occurred in all coastal areas (1930); Far North Coast (1954); present each autumn at Mt. Wilson, immediately above the coastal plain and 60 miles west of Sydney.

Queensland: Confined to coastal districts, the centres of recurring outbreaks being Lockyer Valley, Brisbane, Redland Bay, Nambour, Rockhampton (infrequent), and Bowen (rare).

Victoria: Confined mainly to three potato districts, viz.: Warrnambool, Otway, and Southern Gippsland; also potato districts on the southern slopes of Victoria's Central Highlands but outbreaks occur here to a less extent.

NEW ZEALAND:

Widely distributed over the North Island wherever tomatoes are grown. The area includes Wellington, Manawatu, Wanganui, Taranaki, Wairarapa, Hawkes Bay, Bay of Plenty and Auckland and North Auckland districts. The most important areas for blight are market and domestic gardens in the vicinity of Auckland and Pukekohe (30 miles south).

New Zealand
(Van der Grinten's Proj.
395 miles to the inch)

TASMANIA:

Tasmania
and
King Island
(Van der Grinten's Proj.
395 miles to the inch)

Reported on tomatoes at Ulverstone (Northwest Coast district) and on King Island in Bass Strait.

INDONESIA:

Tomato late blight is known to be in West Java. It is reported verbally to be in Central and East Java, Bali, Sumatra, and the Celebes. Probably present wherever tomatoes are grown.

PHILIPPINE ISLANDS:

Present in the Trinidad Valley and in other localities of Baguio, Mountain Province.

Philippine Islands
(Van der Grinten's Proj.
395 miles to the inch)

Spread; Environmental and Geographic Factors Involved; Potential Danger Spots

AUSTRALIA:

New South Wales: Records from 1910 to 1930 are incomplete and no data on serious outbreaks are available. In 1930 a severe outbreak occurred in all coastal areas. The disease was prevalent again in 1931 and 1932 and occurred in epidemic degree throughout the State in 1933. In 1934 and 1935 it was present but not serious in the coastal regions. Afterward it was of no importance until 1939 and 1940, when it caused slight damage. Trace infections occurred between 1940 and 1950, when the disease recurred in epidemic form, to disappear again in 1951 and 1952.

Climatic conditions of the coastal belt are better suited to the pathogen than those of inland areas.

Queensland: Outbreaks appear to be associated with periods of unusually heavy rainfall during the cooler months. They are most frequent and most serious during June and July but have been recorded during the spring months to as late as November. Rain is probably the most important local means of spread. Temperature appears the main factor in distribution. The potential danger spots are the Lockyer Valley and southeast coastal districts.

"... variation in severity of incidence can be correlated with the temperatures and humidities of the growing season in each area." [q.v. under Distribution]. From Aberdeen, J.E.C. 1949. Tomato diseases and their control, Pamphlet No. 138. Department of Agriculture and Stock, Queensland, Division of Plant Industry.

South Australia: In the Pt. Pirie area (and particularly in the irrigation area around Renmark) there probably has never been any serious introduction of Phytophthora and the climate is too dry and warm for the organism to build up to any noticeable proportions.

In the Adelaide region we are rather at a loss to explain the absence of blight on tomato. Even if the potato strain needs, as suggested by Mills and others, to go through the tomatoes for some generations to be very effective on tomatoes, one might expect that the autumn outbreaks in potatoes would infect nearby outdoor tomatoes, or glasshouse tomatoes some 15-20 miles distant. This apparently never happens. It would seem that our winter-early spring temperatures would be reasonably satisfactory for infection and disease development and if this is so, the limiting factors may be the infrequency of 24-36 hours rainfall along the lines suggested by the Dutch workers. This is supported by the frequent occurrence here of very small isolated patches of blight in potatoes whose development has apparently been arrested by low humidity.

NEW ZEALAND:

In these areas [see under Distribution] tomatoes are grown either in glasshouses or outdoors practically all the year round. The main glasshouse plantings commence in June, and further plantings are carried out later for autumn, late autumn and winter crops. In the field tomatoes are planted from September onwards, and the fruit is being harvested until May.

Infection occurs mainly from neighbouring tomato (and potato) crops which are present for most of the year. Infection is also spread from volunteer potato and tomato plants; also from tomato and potato refuse in soil that has grown an infected crop. Infection may occur under New Zealand conditions at any stage of development from young plants in boxes to mature plants in the field. In glasshouse crops the disease is usually of little economic importance, but in some seasons it causes damage to plants in spring and late autumn.

Our climate in the Auckland district is particularly favourable for development and spread of late blight. For the years 1949-53 inclusive, the average rainfall was respectively 43.11, 40.92, 49.58, 52.42, and 65.47 inches. The average relative humidity ranges from 77 percent to 85 percent. Rainfall is fairly evenly distributed throughout the year, greatest from May to August and least from January to March. Temperatures are as follows: Mean maximum 64.8° F.; mean minimum 53.1° F.; mean 58.95° F. -- these are standard air temperatures taken at 9 a.m.

TASMANIA:

Occurs only in the vicinity of infected potato fields.

INDONESIA:

The spread of tomato late blight and the limiting of its distribution seems to be influenced by environmental and geographical factors. Report from an Extension Service Official in Bandung, West Java states: "Late blight is quite severe on the tomato variety Manalucie grown from seed secured at Bradenton, Florida, U.S.A." The disease is reported to be severe during the rainy season extending in West Java from October through March.

"In the plains there is no Phytophthora infestans (until what height above sea level is not known) so that if it were possible to grow tomatoes there, the mildew would at the same time be eliminated." [ibid. reference as above]. However, there is an attempt now being made to cultivate tomatoes on the coastal plain of West Java.

PHILIPPINE ISLANDS:

The disease assumes epiphytotic severity when the weather is cool and wet, ruining the whole field in a few days. All the vegetative aerial parts of the plant, including the fruit, are affected by the disease. (Refers to Mountain Province).

Damage

AUSTRALIA:

New South Wales: When the disease occurs in epidemic form entire areas of unsprayed tomatoes may be devastated but generally late blight is of no economic importance.

Queensland: It is not regarded as an ever-present danger in this State. Serious outbreaks occur only occasionally. Such outbreaks recorded at this office since 1927, with relevant remarks, are:

August, 1927 -- at Bowen. Associated with abnormally wet weather.
June, 1930 -- at Peak Crossing (Lockyer Valley) in stormy weather.
July, 1934 -- At Annerley (Brisbane suburban area), unusually wet season.
June, 1950 -- Beenleigh (near Brisbane), flood rains at the time.
July, 1950 -- Rosewood, Boonah, Grantham, etc. (Lockyer Valley), abnormally wet weather.

Information on total loss involved during these outbreaks is not available. In many years, loss would be practically nil.

"As Queensland winters are normally dry, epidemics of Irish blight are not common in this State." [Aberdeen, J. E. C. cited under Spread.]

Victoria: The tomato industry has developed in warmer and drier areas of the State; consequently, Phytophthora infestans does not present a problem to the growers.

NEW ZEALAND:

If left unchecked late blight would be responsible for at least 50 percent loss of tomato crops in many parts of the North Island. In severe blight years 75 to 100 percent losses would occur in outdoor crops in Auckland district. Actually if the spray programme evolved by this Division [Plant Disease Division of the Department of Scientific and Industrial Research, Auckland] is efficiently carried out, losses would be negligible. At the present time losses would not exceed 5 to 10 percent, due mainly to inefficient application of control measures.

TASMANIA:

Losses are very slight even in years when late blight is serious on potatoes; economic damage is confined to the fruit.

INDONESIA:

No reports are available on the amount of damage caused by tomato late blight.

At certain periods of frequent rains, the fruits cannot be found in the local Pasars (native markets).

PHILIPPINE ISLANDS:

Under severe infection conditions late in the season from 50 to 80 percent of the fruit may be ruined by the disease. (Refers to Mountain Province).

Control Measures; Effectiveness of These Measures

AUSTRALIA:

New South Wales: Though no actual measurements have been made there is no doubt that growers who have followed this Department's recommendation [Biological Branch, Department of Agriculture, Sydney] of Bordeaux mixture (4-4 ($Ca(OH)_2$-40) have protected their crops to a worthwhile degree. Early blight (Alternaria solani (Ell. & G. Martin) Sor.) occurs annually and most growers of autumn crops apply Bordeaux mixture 2-2-40 as a 10- to 14-day routine. This could account for the low incidence of late blight.

Queensland: Phytophthora infestans of tomato "can be controlled by the use of copper sprays or dusts. Owing to the rapidity with which the disease can spread, the usual practice is to commence application of a fungicide in the seed-bed without waiting for the disease to appear, and to continue treatment throughout that portion of the year in which climatic conditions favourable to the spread of disease may occur. Normally, the interval between applications is 7 to 10 days; this period may need to be shortened if climatic conditions are unusually favourable to the development of Irish blight, whereas during prolonged dry spells it may be increased. As for target spot, it is not advisable to reduce the strength of a dust below 7 per cent. copper. Sprays weaker than the standard 4-2-40 Bordeaux mixture could possibly be used, but thoroughness of application must never be neglected."

Victoria: The only control measure for tomatoes advocated by this Department [Department of Agriculture, Victoria] is the application of a suitable copper dust or spray. However, growers normally take no precautions against late blight.

NEW ZEALAND:

Copper sprays, either Bordeaux mixture 6-8-100 or copper oxychloride 5 lb.-100 gallons, are recommended. It is essential that application is commenced early in the season preferably before plants are set out in the field, and thereafter every 10 to 14 days. The interval between sprays can usually be lengthened in the January-March period, but this depends on weather conditions. If the above schedule is efficiently carried out, late blight is effectively controlled.

TASMANIA:

Special control measures are scarcely warranted under our conditions. We do recommend either 4.2.40 Bordeaux mixture, or 1 lb. of copper oxychloride per 40 gallons (Imperial), but in practice it is rarely, if ever, used on tomatoes.

INDONESIA:

Very little control work is done to prevent or to control tomato late blight. Bordeaux mixture is used in the rather extensive potato plantings in the mountain area around Bandung, West Java. Thung states: "tomato cultivation... is rather expensive because of the need to spray plants with Bordeaux mixture against the above-mentioned mildew."

Strains; Varietal Resistance

AUSTRALIA:

New South Wales: There is no evidence of varietal resistance in any of the commercial varieties of tomatoes grown here. These varieties are chiefly Rouge de Marmandie and Grosse Lisse. No work has been done on strains of the fungus.

Queensland: No information has been obtained here on the possibility of strain differentiation within this parasitic species.

Victoria: During the past three years we have been actively interested in Phytophthora infestans, but there have been no infected tomato plants or fruits from which to isolate the pathogen. Repeated isolations from potato tubers and plants and also field indicator plots have not revealed evidence of more than one potato strain. We have no evidence of varietal host resistance to this disease.

NEW ZEALAND:

Regarding strains of Phytophthora infestans present in New Zealand, work is being carried out on this project at the present time at Crop Research Division, Lincoln, Christchurch, in conjunction with breeding for resistance against blight of potatoes. We have the common strain and several others that have not yet been identified.

We have little evidence of varietal resistance of tomatoes to blight in this area. All the varieties grown commercially are susceptible.

TASMANIA:

The Department [Department of Agriculture, Hobart] is currently undertaking a potato breeding programme, in which one of the objectives is late blight resistance. We are also investigating the environmental factors influencing late blight, as the disease is sporadic here and therefore regular preventive spraying is unwarranted. We hope to institute a warning service this season, as work to date suggests that the "Irish Rules" apply under our conditions.

Bibliography:

* - Indicates references furnished by cooperators.
All others were taken from available literature.

Aberdeen, J. E. C. 1945. Diseases of the tomato and their control. Queensland Agr. Jour. 60: 277-299.

_____. 1947. Seasonal notes on tomato diseases. Queensland Agr. Jour. 64: 219-220.

* _____. 1949. Tomato diseases and their control. Pamphlet No. 138, Dept. of Agric. and Stock, Queensland. 42 pp. Also, In Queensland Agr. Jour. 68: 330-344; 69: 10-25, 86-91, 146-152.

Anonymous. 1931. New South Wales: Plant diseases. Intern. Bull. Pl. Prot. 5: 202-205.

_____. 1942. Plant diseases. Tomato diseases and how to control them. Agric. Gaz. N. S. W. 53: 380-387.

_____. 1950. Plant diseases. Late blight of tomato. Agric. Gaz. N. S. W. 61: 517-521, 587-590.

* _____. 1954. Tomato diseases. Part I. Soil-borne diseases. Tasmanian Jour. Agr. 25:134-142.

_____. 1954. Tomato diseases. Part II. Diseases of leaves, stems and fruit. Tasmanian Jour. Agr. 25: 134-142.

Atkinson, J. D., R. M. Brien, et al. 1949. Tomato diseases and pests in New Zealand and their control. New Zeal. Dept. Sci. & Indus. Res. Inform. Ser. 2. 112 pp.

Brittlebank, C. C. 1920. Tomato diseases. Jour. Agric., Victoria 19: 231-235.

* Cass-Smith, W. P. 1947. Late or Irish blight of potatoes. Jour. Dept. Agric. Western Australia 24 (Second Series): 354-360.

* _____. 1952. Late or Irish blight of potatoes. Leaflet No. 2009. Reprinted from Jour. Dept. Agric. Western Australia 1 (Third Series): 505-506.

Fajardo, T. G. 1934. Plant disease problems confronting truck farmers in Trinidad Valley and the vicinity of Baguio, Mountain Province, Philippine Islands. Philipp. Jour. 53: 67-95.

Fish, S. 1939. Tomato diseases and their control. Jour. Dept. Agric., Victoria 37: 378-391.

Helson, G. A. H. 1953. Outbreaks and new records: New Zealand. FAO Plant Prot. Bull. 1: 121-122.

* Jacks, H. 1947. A survey of tomato diseases under glass. New Zealand J. Sci. Tech., A, 29: 164-169.

Johnston, T. H. 1910. Irish blight in tomatoes. Agr. Gaz. N. S. W. 21: 563-566.

Kirk, T. W. 1906. Report of the Biologist. New Zealand Dept. Agric. p. 351.

Magee, C. P. and F. C. McCleery, 1937. The occurrence of plant diseases in New South Wales with particular reference to the three-year period ending 30th June, 1936. Dept. Agr. N. S. W. Sci. Bull. 57: 1-42.

McAlpine, D. 1910. The late blight in tomatoes. Jour. Dept. Agr. Victoria 8: 48-49.

_____. 1911. Tomatoes and Irish blight. Jour. Dept. Agr. Victoria 9: 379-382.

Morgan, W. L. and P. C. Hely. 1941. Combined sprays for late tomatoes. Jour. Austral. Inst. Agric. Sci. 7: 161-62.

Noble, R. J. 1935. Australia: Notes on plant diseases recorded in New South Wales for the year ending 30th June, 1934. Intern. Bull. Plant Prot. 9: 1-8.

Orton, Clayton R. 1916. Phytophthora infestans on tomatoes in Australia. Phytopath. 6: 447.

Reinking, Otto. 1919. Philippine plant diseases. Phytopath. 9: 114-140.

Ross, G. D. 1931. The Biologist. Rept. Dept. Agr. Legislative Assembly, New South Wales, 1930: 19-20.

Simmonds, J. H. 1927. Irish blight of tomatoes. Queensland Agr. Jour. 28: 453-455.

_____. 1936. Diseases of the tomato. Queensland Agr. Jour. 45: 5-11.

_____. 1938. Plant diseases and their control. Part II. Queensland Agr. and Pastoral Handbook 3: 117-232.

Taylor, G. G. 1945. Bordeaux mixture, copper oxychloride, and copper oxide sprays for control of late-blight of tomatoes. New Zeal. Jour. Sci. Tech., 1945, (27) Sec. A, 9-13.

Taylor, W. H. 1917. Tomato culture. New Zealand Jour. Agric. 15: 278-283.

* Tryon, H. 1909. Report of the Entomologist and Vegetable Pathologist. In Rept. Dept. Agric. Queensland 1908-09.

*_____. 1910. Report of the Entomologist and Vegetable Pathologist. In Rept. Dept. Agric. Queensland 1909-10.

_____. 1925. Tomato blight disease. Queensland Agr. Jour. 24: 239-242.

Veitch, Robert and J. H. Simmonds. 1929. Pests and diseases of Queensland fruits and vegetables. 198 pp. Brisbane.

SOUTH AMERICA

First Report

ARGENTINA:

Mentioned in the literature as found in 1912 causing death of many tomato fruits.

Found at Tinogasta (Catamarca) in 1919 on leaves and stems; on leaves and fruits in Temperley, F.C.S. in 1921.

BOLIVIA:

No record of the occurrence of Phytophthora infestans on tomato; reported, however, to have been isolated from tomato that was grown near Cochabamba.

BRAZIL:

State of São Paulo: Our first record of late blight on tomato is January 20, 1938 in the neighborhood of the city of São Paulo.

Additional records include: First occurrence in 1926 on leaves of tomato from Camassary, Bahia State; 1929 at Vicosa, Minas Gerais State.

BRITISH GUIANA:

Phytophthora infestans on tomato has not been recorded in British Guiana.

COLOMBIA:

Found in 1929 at la Cumbre, a small locality about 1900 meters in altitude, near Cali, Valle Department. [Cf. Chardon and Toro. 1930. Mycological explorations of Colombia. Jour. Agric. Porto Rico 14: 1-369].

Possibly an earlier record for Phytophthora infestans has been noted on potatoes, at the Bogota plain, in 1908.

ECUADOR:

Phytophthora infestans reported on tomato [cf. Molestina, E. 1942. Indice preliminar de las principales enfermedades y plagas de la Agricultura en el Ecuador. Boletin del Dept. Agric. No. 15. 25 pp.] .

PERU:

First (written) report on the presence of Phytophthora infestans on tomato was in 1931 as found in the environs of Lima.

SURINAM:

No record of late blight on tomato in Surinam.

URUGUAY:

Late blight on tomato was reported for the first time in Uruguay in 1944 on samples collected in the vicinity of Montevideo.

VENEZUELA:

First date of appearance unknown.

Distribution

BRAZIL:

Brazil
(Van der Grinten's Proj.
632 miles to the inch)

Tomato late blight is spread in all tomato districts of São Paulo State. There are records of the disease in the Distrito Federal (Rio de Janeiro), and the States of Minas Gerais and Rio Grande do Sul. It has also been reported from the States of Espirito Santo, Parana, and Santa Catarina.

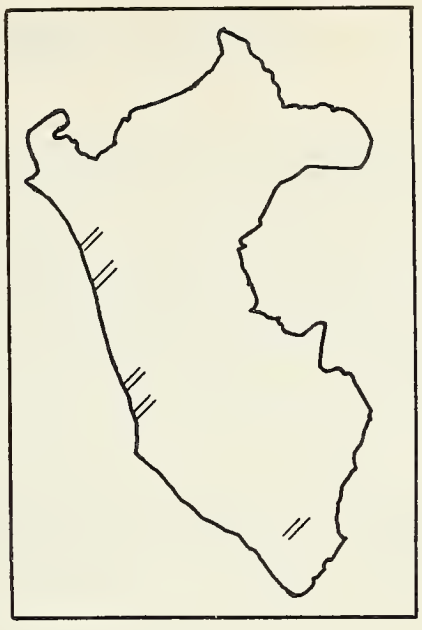
COLOMBIA:

The disease is known to occur in El Valle del Cauca, Caldas Department, at 1,000 meters elevation and in Antioquia Department. It is probably present in other areas of the country.

Colombia
(Van der Grinten's Proj.
395 miles to the inch)

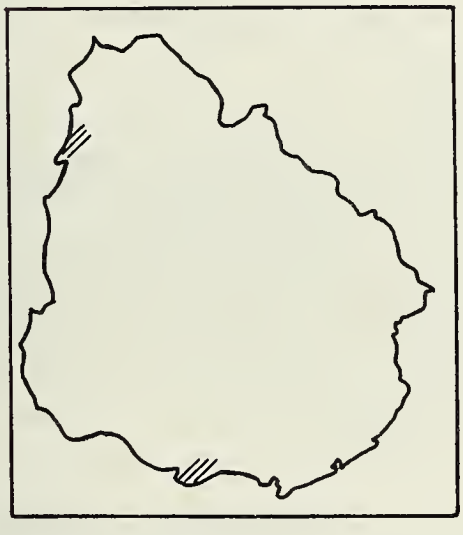
PERU:

Phytophthora infestans on tomato is found in the Departments of Lambayeque, La Libertad, Lima, and Arequipa. It is possibly generally present in the whole of the Sierras in the small plantings grown.



Peru
(Van der Grinten's Proj.
395 miles to the inch)

URUGUAY:



Uruguay
(Chamberlin Trimetric Proj.
126.3 miles to the inch)

Late blight is found in the environs of Montevideo; it is found also on early planted field crops of tomato growing in the neighborhood of the city of Salto.

It has not been reported from other places where tomatoes are grown, probably because they are grown when the environmental conditions are not so favorable for Phytophthora infestans to appear.

VENEZUELA:

The disease occurs in all parts of Venezuela, and, in general, the severity depends upon rainfall.

Venezuela
(Van der Grinten's Proj.
395 miles to the inch)

Spread; Environmental and Geographic Factors Involved; Potential Danger Spots

BRAZIL:

State of São Paulo: In general, tomato fields have small areas, more or less isolated and not very near potato fields. It is believed the potato late blight is not the principal source of inoculum.

Weather conditions are the factors most important in the spread of the disease. These conditions were studied for the State of São Paulo [cf. Andrade, A. C. de. 1951. Basis for the forecasting of late blight epiphytotics of tomato in São Paulo. Arquivos do Instituto Biologico 20: 95-108].

The tomato crop is grown in the open all year round, but the crop is limited in some regions by spotted wilt in summer and in others by drought or frost in winter.

COLOMBIA:

Late blight is spread by wind-splashed rain. The disease is more prevalent at medium elevations, 1000 to 1800 meters. Warm, dry weather seems to check the disease.

PERU:

On the central Peruvian Coast, especially in the Department of Lima, and in the Department of Arequipa, the increase in cultivation of the potato can be one of the factors in spreading the disease. In the Departments of Lambayeque and La Libertad (coast) the fungus possibly is confined to the tomato and other Solanaceae.

The prevailing conditions (high atmospheric humidity and appropriate temperature) are undoubtedly the essential factors for the spread of this disease, to which is added the increase in the cultivation of the potato and, similarly, the tomato.

On the Peruvian Coast, especially around Lima, tomatoes can be cultivated during the whole year. In recent years, however, it has been observed that plantings made in March and April were subject to attack by Phytophthora infestans and if the prevailing weather conditions were favorable, 100 percent of the crop was lost. In the plantings made in November and December the disease is not present and the only problem that the agriculturists have is the control of insects (actually controllable).

In the Department of Piura, in the North, perhaps the disease will not be destructive because in the period in which tomatoes are grown, prevailing conditions, low atmospheric humidity and very high temperature, do not favor the disease.

Serious losses could possibly be produced in the Sierras if spread occurs in a period favorable to the disease.

URUGUAY:

The principal means of spread are potato crops. There are no geographical factors able to limit the distribution of Phytophthora infestans in this country; the only limiting factors are the weather conditions. The period during which the disease appears in susceptible varieties is during the end of March until November. During the summer months we have never received any records of plants being attacked by the disease. We suppose the principal means of spread are potato crops which in some parts of the country are grown practically throughout the whole year, for example in Rincón del Cerro, near the city of Montevideo.

VENEZUELA:

Rains and fogs greatly favor the spread of late blight. From a geographic point of view, growers located in pocket canyons and valleys that are blocked experience more difficulty, primarily because of less air circulation and correspondingly high humidities with accompanying fogs.

In the central zone (States of Lara, Yaracuy, Carabobo, Aragua, Miranda, and the Distrito Federal) in bottom lands damage is severe if there are unseasonable rains. The States of Lara (northern part) and Falcón (southern part) are essentially dry states almost the entire year and consequently suffer much less than other areas.

Damage

BRAZIL:

State of São Paulo: The damage in severe blight years is about 60 percent of the yield; in moderate infection less than 20 percent of the yield.

COLOMBIA:

No accurate estimates have been made of the losses due to the disease. In (a) severe blight years it is common to observe total losses due to foliage destruction and fruit rotting, and (b) in years of moderate infection there is only a mild attack on the foliage and but little fruit rot.

PERU:

In years of severe infection, in the central Peruvian Coast (plantings in March and April), practically 100 percent of the crop is lost. In the few favorable years, it is limited to light attacks on the leaves.

URUGUAY:

No statistical data have been reported.

VENEZUELA:

There are no figures available for the amount of damage caused in either severe or moderate infection. Very little control is practiced.

Control Measures; Effectiveness of These Measures

BRAZIL:

State of São Paulo: Spraying with Bordeaux mixture, Phygon or Dithane Z-78 gives economical control of the disease. The effectiveness of the control depends on spraying at the right time, i.e. in the period of rain and low temperature. The farmers now are well-informed about the correlation between weather conditions and disease and, therefore, the control of the disease is improving and the claims against its damage are reduced.

For figures of experiments in the control of late blight of tomato, indicating the intensity of the disease as percent of fruits spotted by late blight, cf. Andrade, A. C. de. 1952. Fungicidas modernos para controlar a requeima de tomatiero. Biológico 18: 6-14.

COLOMBIA:

Cultural practices, like pruning the lower leaves, have given very good results in preventing initial infections.

Spraying with Bordeaux (4-4-50), copper oxychlorides, or Dithane Z-78 is recommended.

In heavy rainy seasons no control is observed even if spraying is done at 6-day intervals.

PERU:

Plantings are made in November and December (coast) to escape the dangerous months (May to September).

In the Sierras, the July plantings possibly escape.

URUGUAY:

We recommend the use of Bordeaux mixture at 1% or any copper oxychloride of 50% copper at 0.5%.

VENEZUELA:

Control is a relative matter. Chemicals are expensive and are generally used only by the larger growers. The "conuquero" (squatter) does not use them as a rule.

Until about 1948 Bordeaux mixture was used on both seedbeds and in the field. Since then neutral coppers, such as Copper A, Tribasic, etc., are used. Dosage is 2 kilograms per 400 liters.

As for schedule, the plants are rarely sprayed as a protectant on a regular schedule. Instead, as the disease appears spraying commences. Most growers who spray know that coverage is important, but the job "leaves much to be desired". The carbamates as a rule are not used, primarily because they are more expensive than the coppers.

Some spray experiments have been carried on in the Sanare region of the State of Lara at an altitude of 1200 meters above sea level. The results (for one season) were good and all chemicals used, viz.: Phygon XL, Sr 406, Tribasic copper, Copper A, Tribasic alternated with Fermate, Fermate, Parzate alternated with Copper A, Zerlate, and Parzate, gave significant control. The first five named were the best, ranging from 8 to 4 times the yield of the control.

Strains; Varietal Resistance

BRAZIL:

State of São Paulo: We do not have information about strains of Phytophthora infestans in Brazil.

COLOMBIA:

Race "A" is widely disseminated through the Bogota plain and eastern Andean Cordillera. Biotype "D" is infrequent and of limited distribution. [Cf. Rojas, E. de and N. Estrada. 1953. El problema de las razas fisiologicas de Phytophthora infestans (Mont.) de Bary. Colombia Ministerio de Agricultura, Div. Investigacion Informacion Tec. 1: 1-78.]

PERU:

The physiological races of Phytophthora infestans, determined in Peru, according to the scale of Dr. Black, are the following: A, D, C [cf. Segura, Consuelo Bazán de. 1952. Razas fisologicas de Phytophthora infestans en el Peru. Centro Nac. de Invest. y Exp. Agric., La Molina, Boletin 46]; I and J [cf. Black, W., et al. 1953. A proposal for an international nomenclature of races of Phytophthora infestans and of genes controlling immunity in Solanum demissum derivatives. Euphytica 2: 173-179].

The races, according to the International Scale will have the following numbers: A = 0, D = 1, C = 2, J = 3, I = 3,4.

With regard to the work on resistant varieties of tomato, nothing has as yet been accomplished in Peru.

URUGUAY:

No studies have been done on strains of Phytophthora infestans.

VENEZUELA:

No information is available on strains, nor on varietal resistance. However, there is a native tomato that "seems" to stand up better than commercial varieties.

Bibliography:

* - Indicates references furnished by cooperators.
All others were taken from available literature.

Abbott, E. V. 1929. Diseases of economic plants in Peru. Phytopath. 19: 645-656.

Amaral, J. Franco do. 1951. Principais doenças das plantas cultivadas no estado de São Paulo e seus respectivos tratamentos. Biológico 17: 179-188.

*Andrade, A. C. de. 1951. Bases para a previsão do aparecimento de surtos de "requeima" do tomateiro em São Paulo. [Basis for the forecasting of late blight epiphytotics of tomato in São Paulo]. Arquivos do Instituto Biológico 20: 95-108.

*_____. 1952. Fungicidas modernos para controlar a requeima do tomateiro. [Modern fungicides for control of tomato late blight]. Biológico 18: 6-14.

_____. 1952. A requeima do tomateiro no Vale do Paraiba. [Tomato blight in the Parahyba Valley]. Biológico 18: 35.

_____. 1953. Experiencias sobre a dosagem de cal na calda Bordaleza. [Tests of the proportion of calcium in Bordeaux mixture]. Biológico 19: 45-56.

Anonymous. 1938. Informe del departmento de botanica y fitopatologia. Venezuela Ministerio de Agr. y Cria Memoria Vol. Adicional (Labores Technicas) Vol. 2: 41-72.

_____. 1953. La labor de la Estación Experimental en el ano 1952. [The work of the experimental station in 1952]. Publ. Misc. Estac. Exp. Agric. Tucuman No. 6. 50 pp.
In re tomato hybrids and selections resistant to drought and to Phytophthora.

Averna-Sacca, R. 1917. As molestias cryptogamicas das plantas horticolas. Bol. Agric. São Paulo 18: 382-416; 486-515; 567-583; 634-654.

*Chardon, C. E., R. A. Toro, et al. 1930. Mycological explorations of Colombia. Jour. Agric. Porto Rico 14: 1-369. See p. 219.

*Deslandes, J. A. 1945. Fatos sôbre doenças do tomateiro. Reprint from Bol. Minist. Agric. Rio de Janeiro. 70 pp.

Fennell, J. L. 1948. Temperate-zone plants in the tropics. Econ. Bot. 2: 92-99.

Frezzi, Mariano J. 1950. Las especies de Phytophthora en la Argentina. [The species of Phytophthora in Argentina]. Rev. de Invest. Agr. 4: 47-134.

Girola, C. D. 1922. Enfermedades del tomate en Argentina. Bol. del Ministerio de Agricultura de la Nación 27: 503-504.

_____, and J. J. Aranjo. 1925. Enfermedades de las plantas. Lista de las observadas en la Republica Argentina in the years 1918 to 1923. Publicación del Museo Agricola Soc. Rural Argentina No. 46. 46 pp.

Huergo, Jose M. 1905. Enfermedades de algunas plantas cultivadas en el Paraná. Bol. Min. Agric. Nacional Argentina 2: 235-240.

Molestina, Ernesto. 1942. Índice preliminar de las principales enfermedades y plagas de la agricultura en el Ecuador. Bol. del Departamento de Agricultura No. 15. 25 pp.

*Muller, A. S. 1934. Brazil: Preliminary list of diseases of plants in the State of Minas Gerais. Moniteur Inter. Def. Plantes, 1934: 193-198.

_____. 1941. Lista de los parasites vegetables de las plantas cultivadas. Bol. Soc. Venezuelana Cienc. Nat. 7, no. 48: 99-113.

Renacco, R. 1916. Sobre algunas enfermedades parasitarias de las plantas cultivadas. Anales Soc. Cientifica Argentina 81: 62-70.

*Rojas, E. de and N. Estrada. 1953. El problema de las razas fisologicas de Phytophthora infestans (Mont.) de Bary. Colombia Ministerio de Agricultura, Div. Investigación Información Tec. 1: 1-78.

Segura, C. Bazán de. 1952. Razas fisologicas de Phytophthora infestans en el Peru. Investigaciónes sobre resistencia de especies variedades e hibridos de Papa al Phytophthora infestans in el C.N.I.E.A. "La Molina" 1951. Departamento de Fitopatologia, Centro Nacional de Investigación y Experimentación Agricola, La Molina, Boletin 46. 16 pp.

_____. 1953. Principales enfermedades de la plantas en el Peru. Departmento de Fitopatologia, Centro Nacional de Investigación y Experimentación Agricola, La Molina, Boletin 51. 46 pp.

*Silva, S. G. da. 1939. Late blight from the State of Espirito Santo. Rev. Soc. Brasil Agronomia 2: 80-84.

_____. 1940. Lista preliminar dos doenças das plantas do Estado do Espriito Santo. [A preliminary list of the plant diseases of the State of Espirito Santo]. Bol. Ministerio Agric. Rio de Janeiro, 1939. 12 pp.

Vallejos, P. S. 1935. Enfermedades de algunas plantas cultivadas en el Departamento de Ancash. Bol. Compan. Administr. Guano 11: 45-51.

CENTRAL AMERICA

First Report

COSTA RICA:

Tomato late blight was probably reported in Costa Rica at least 50 years ago; no actual date is known [to writer].

EL SALVADOR:

No record of first report; known that tomato late blight is present and apparently has been for many years.

GUATEMALA:

No published records of the occurrence of late blight in Guatemala.

HONDURAS:

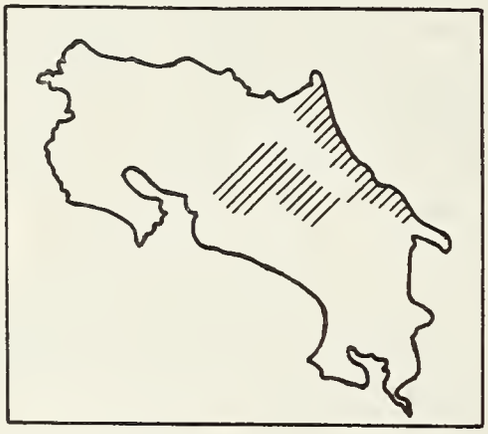
Phytophthora infestans was reported on tomato in 1952 [cf. Plant Disease Records at Zamorano, Honduras, 1950-1952. Ceiba 3, 2, p. 85-91. 1952], after it had been observed in 1949, 1950, and 1951 in Honduras. Believed to have been present for many years.

Distribution

BRITISH HONDURAS:

Phytophthora infestans probably does occur in British Honduras; tomatoes are grown on a comparatively small scale.

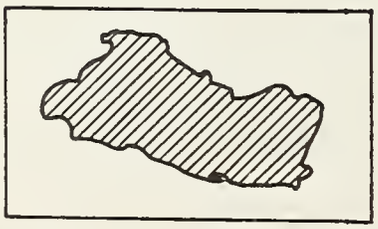
COSTA RICA:



Costa Rica
(Transverse Mercator proj.
94.7 miles to the inch)

Tomato late blight is well distributed in the Atlantic and Pacific watersheds of Costa Rica, with greater incidence in the more rainy Atlantic and Central Plateau areas. The Central Plateau regions of San Jose and Alajuela produce the best tomatoes and, due to drier atmospheric conditions and other factors, the incidence of Phytophthora infestans is also less severe.

EL SALVADOR:



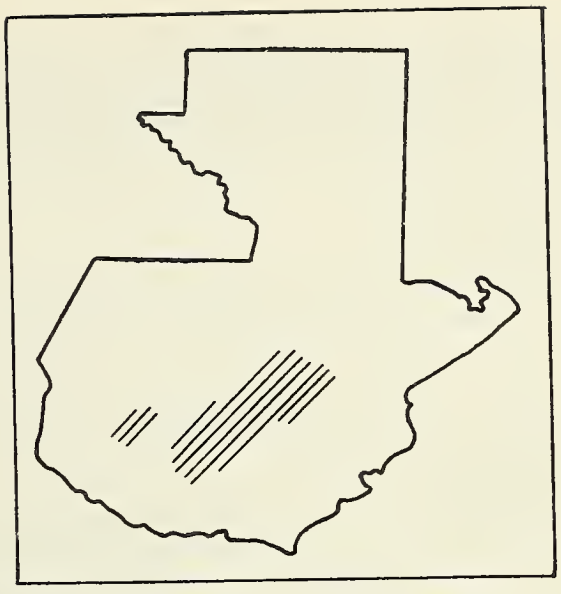
El Salvador
(Transverse Mercator proj.
94.7 miles to the inch)

Late blight appears to be present on tomatoes throughout the country; the country is small, densely populated, and intensely cultivated.

GUATEMALA:

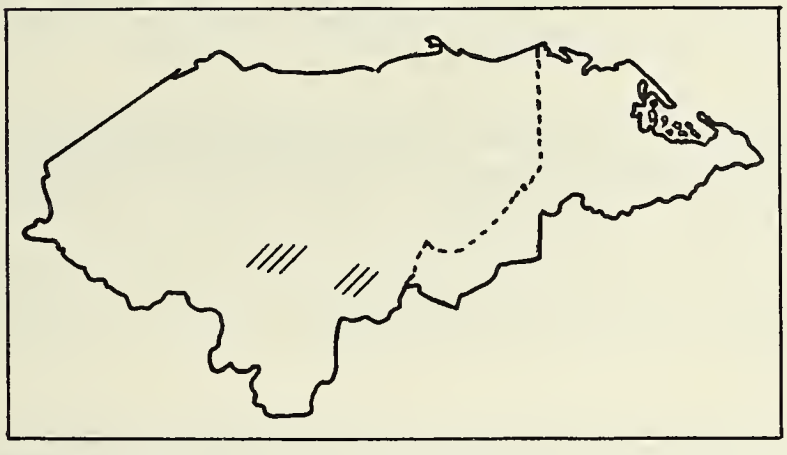
The disease has been found in the Departments of Guatemala, Sacatepeques, Chimaltenango, Quezaltenango, Progreso and Baja Verapaz.

In general, late blight in Guatemala is present at altitudes ranging from 3000 to 7500 feet provided there is abundant humidity. The disease occurs principally in the rainy season between May and October.



Guatemala
(Transverse Mercator proj.
94.7 miles to the inch)

HONDURAS:



Honduras
(Transverse Mercator proj.
94.7 miles to the inch)

The present distribution includes two locations, the region of Tegucigalpa and Danli in the highlands, 2,500 to 4,000 feet. However, we believe that the disease can be found in gardens nearby most highland towns, but not on the seacoast.

Spread; Environmental and Geographic Factors Involved; Potential Danger Spots

COSTA RICA:

Phytophthora infestans spreads here mainly by wind-carried rain droplets and heavy mists. The prevailing moisture-laden easterly winds during most of the year favor the spread of late blight, but on the Carpintera mountain between Cartago and San Jose most of the moisture precipitates and the main part of the valley from Tres Rios to Palmares is considerably drier.

EL SALVADOR:

There is no reason to suspect that there are any effective major environmental or geographic barriers to the spread of the late blight organism.

Tomatoes are grown only in small patches; there have been no successful attempts at commercial production. Because of low production, tomatoes are a high-priced luxury.

Since tomatoes are grown in the rainy season, we would guess that rain and associated air currents serve as effective means of dissemination of this organism.

GUATEMALA:

The means of spread are probably wind and splashing rain water. It has been observed that tomatoes remain free of disease during severe years when they are planted in isolated places and where no tomatoes have been planted before. Fluctuating temperatures seem to favor the spread of late blight in Guatemala. Cool temperatures at night and warmer ones during the day, with a high relative humidity, are perhaps the main environmental factors contributing to disease development.

HONDURAS:

The disease seems to be limited to the highlands where there may be a drop in temperature of some 30 degrees between afternoon and early morning. It is a rainy-season disease, May to November. Dew is heavy in the highlands.

There are no reports from sea-level coastal towns which are pretty hot.

Damage

COSTA RICA:

In severe years there is a total loss from Phytophthora infestans, since the foliage and fruit are affected. In years of moderate infection from 25 to 40 percent of the crop may be lost. In most of our drier seasons (roughly December to May) losses probably do not amount to over 10 to 15 percent in the Alajuela-San Jose area.

EL SALVADOR:

We have no records on damage from late blight.

GUATEMALA:

It is difficult to evaluate the damage from late blight in Guatemala, as practically no tomatoes are grown in the country during the rainy season from May to October. The fear of having complete loss has caused growers to grow tomatoes only during the dry season.

HONDURAS:

In the highlands there appeared to be no difference over four years, 1949-1952, as to the years being severe blight years or years of moderate infection. In 1953 the period from May to November was very dry. There was no rainy season and most crops were lost to drought. I doubt if there was much Phytophthora that year.

Control Measures; Effectiveness of These Control Measures

COSTA RICA:

Control measures advocated include the organic fungicides and coppers. Dithane Z-78 (and tribasic copper sulfate to a lesser degree) has been used widely up to recent times, with varying degrees of success. Effectiveness cannot be reported accurately here because of the lack of experimental evidence. However, our feeling is that timely applications and better equipment or method of application of any of the better fungicides would increase their effectiveness here.

EL SALVADOR:

We have borrowed our recommendations for control of late blight from the States [U.S.]. Most fungicides used in the country are copper compounds.

GUATEMALA:

Control measures are not practiced in Guatemala for late blight. Tomato plantings are started in November when the blight danger is over. Occasionally attacks occur during November and December. However, no attempts are made during this time to control late blight. In only one case was a successful crop obtained during the rainy season by a commercial grower. He sprayed with Bordeaux mixture during the whole cycle of the crop.

HONDURAS:

Bordeaux mixture is the spray used as a control measure. Fungicides are not readily available commercially in Honduras, but materials for Bordeaux can be obtained. Little spraying is done in Honduras. Bordeaux is effective against tomato blights in Honduras.

Strains; Varietal Resistance

COSTA RICA:

No strains of Phytophthora infestans on tomato have been reported for Costa Rica. This fungus occurs on all standard U. S. commercial varieties grown here and on a local form of Lycopersicon cerasiforme. P. infestans developed promptly at Turrialba on Southland about 1949.

On potatoes P. infestans exists in all cool highland areas, especially in the rainy season. Race D is now more or less prevalent on three race D-susceptible varieties of potatoes that are being grown here at present.

EL SALVADOR:

We have no information on strains of Phytophthora infestans or resistant varieties. However, we suspect that the primitive method of growing tomatoes (i.e. in scattered small patches, saving own seed, no rotation, etc.) would lead to the natural selection of strains of both parasite and host.

GUATEMALA:

It is not known how many races of Phytophthora infestans are in Guatemala. Most of the commercial varieties grown in the country are introduced from the U. S. and are completely [susceptible] to late blight.

HONDURAS:

There is no accurate information on strains of Phytophthora in Honduras. Since, frequently, the intensity of foliage infection did not correspond with the intensity of fruit rotting, and vice versa, it may be that more than one strain is present. Some lines of Marglobe showed resistance to foliage blight.

Bibliography

* - Indicates reference furnished by cooperator.
Others were taken from available literature.

*Muller, Albert S. 1952. Plant disease records at Zamorano, Honduras, 1950-52. Ceiba 3: 85-91.

_____. 1953. Plant disease problems in Central America. F.A.O. Plant Prot. Bull. 1: 136-138.

Palm, B. 1932. Pflanzenkrankheiten aus Guatemala. Zeit. Pflanzenkr. 42: 11-17.

BERMUDA; WEST INDIES; CARIBBEAN REGION

First Report

BERMUDA:

One record of late blight affecting tomatoes in Bermuda; made in January and February, 1934, on the fruit. Authenticity of this record remains in some doubt.

No records of Phytophthora spp. on tomato foliage in Bermuda.

BRITISH WEST INDIES:

Jamaica: The disease was first recorded here by Ashby in 1916.

Montserrat: First recorded in Montserrat (Leeward Islands of the Lesser Antilles) in 1939.

Trinidad: Phytophthora infestans has never been recorded in Trinidad.

CUBA:

Late blight was first reported in Cuba in 1945.

DOMINICAN REPUBLIC:

Late blight was reported in this country for the first time in 1927.

REPUBLIC OF HAITI:

Mildew of tomato was discovered in Haiti about 1945 in a leaf specimen from a plantation at sea level in environs of Port-au-Prince.

The disease existed, no doubt, previous to discovery as it has been known for a long time on potato. Tomatoes are frequently planted near potato fields at the higher altitudes.

Distribution

BRITISH WEST INDIES:

Jamaica
(Transverse Mercator Proj.
94.7 miles to the inch)

Jamaica: The disease is present wherever the crop is grown in Jamaica. Approximately 2,000 acres are planted with tomatoes yearly, mostly on the flat plains along the south coast, but small patches are to be found all over the Island.

CUBA:

Cuba
(Chamberlin Trimetric Proj.
173.6 miles to the inch)

From 1946 onward the disease has spread through all the tomato zones of the country to such an extent that wherever tomatoes are grown Phytophthora infestans is present.

The disease has spread throughout the Island without regard to geographical barriers, such as mountains, etc.

DOMINICAN REPUBLIC:

The regions where late blight is most prevalent are: San Cristobal and Bani, district capitals ("comunes cabeceras") of the province of Trujillo and Trujillo Valdez, respectively. Areas free from the disease are the regions of San Jose de Ocoa, in the province of Trujillo Valdez; San Juan de la Maguana, district capital of the province of Benefactor, and Constanza in the province of La Vega.

Dominican Republic
(Transverse Mercator Proj.
94.7 miles to the inch)

REPUBLIC OF HAITI:

Haiti
(Transverse Mercator Proj.
94.7 miles to the inch)

At sea level and up to 400 or 500 meters of altitude, the disease is very rare. However, it is rather abundant in the cool and humid regions of Kenscoff, for example (about 20 kilometers from Port-au-Prince), at 1200 meters of altitude, about 20° C on the average in summer and 12° C in winter.

On the flat the tomato is planted in November-December when the temperature is in the neighborhood of 25° C on the average.

Spread; Environmental and Geographic Factors Involved; Potential Danger Spots

BRITISH WEST INDIES:

Jamaica: It is generally worse during showery weather or when there are hot days and cold nights as occur in several sections of Jamaica during the winter months when tomatoes are chiefly grown.

CUBA:

As far as can be determined, the principal means of the spread of the disease is by wind although very possibly other factors are involved.

There are no environmental or geographic factors influencing the spread or limiting the distribution of the disease. As can be seen from a map of Cuba, the principal mountain ranges are close to either the north or south coasts and any land between these ranges and the nearest coastline is not planted to tomato but is planted with either rice or cane. At the same time cattle are raised on much of this particular land such as that in the Province of Pinar del Rio. This, of course, means that there are no barriers, such as mountains, to prevent the spread of the disease, the rest of the land being comparatively flat, thus facilitating the spread, the spores being carried by the wind.

DOMINICAN REPUBLIC:

The principal means of dissemination of late blight of tomato are;

(a) Use of untreated, unselected seed.

(b) Presence of the fungus in host plants such as potato and certain wild Solanaceae in the neighborhood of tomato plantings.

Geographical and environmental conditions influence the spread of late blight in regions of high humidity (the coastal portions of the country) with a temperature of 27-29° C. In the interior, where temperature and humidity are much lower than those cited, the disease has not been found on tomato. Plantings in the coastal localities of the provinces of Trujillo and

Trujillo Valdez are places of greatest danger of attack.

REPUBLIC OF HAITI:

It seems that the principal factors which favor the development of mildew of tomato in Haiti are a cool temperature and a humid period. Rain is the principal agent of spore distribution.

Damage

BRITISH WEST INDIES:

Jamaica: No survey has been made of the amount of damage or loss caused thereby.

CUBA:

Since the first report of the disease, and especially in the last two or three years, it would be impossible to separate years of severe blight from those of moderate infection; apparently the disease is progressively getting worse, so instead of noticing any less damage in any year which we could call a better year, the opposite is true. When control measures are not practiced, tomatoes are not harvested.

DOMINICAN REPUBLIC:

The greatest damage caused is estimated at 8 percent of total crop; the lowest estimate at 0.5 percent.

REPUBLIC OF HAITI:

Late blight has not been seen up to the present in the vast plantations of tomatoes in the mountains, where one encounters the propitious conditions for the development of Phytophtora. Not infrequently the small, extended, scattered and more or less isolated plantings can, likewise, avoid infection.

In the plain of Artibonite at sea level not a single case was observed during the last two years in the extensive tomato plantings.

Control Measures; Effectiveness of These Measures

BRITISH WEST INDIES:

Jamaica: Spraying with Bordeaux mixture, Perenox, or Dithane D-14, every 7 to 10 days, has given fairly good control.

CUBA:

Up until the past 5 years or so, Bordeaux mixture was the only means of control, which was none too effective. After Bordeaux mixture, growers switched to basic copper and recently to cuprous oxide, none of which is as effective as the dithiocarbamates.

The best control measures so far found have been the applications of Dithane, of Rohm & Haas, or Parzate, of DuPont. Both these products seem to hold the disease in check even after infection, whereas the copper compounds apparently do not do so. Very often late blight attacks the seedbeds, so within the past two years it has become the practice to spray at intervals of approximately 5 days from the time the plant reaches a height of 2 inches until harvest. This is especially true for low-lying districts where morning mists are prevalent; fields planted on higher grounds are sprayed or dusted at intervals of 7 to 10 days. The organic fungicides have been giving good results but, as in other countries, must be considered as preventatives. It can truthfully be said that if it were not for zineb-type fungicides, the tomato crop in Cuba would be practically non-existent.

DOMINICAN REPUBLIC:

Control measures practised for late blight of tomato, with good results, consist of the application of the fungicides Dithane Z-78, Manzate, and Zerlate.

REPUBLIC OF HAITI:

In general, we do not treat the plants against mildew. However, the applications of Bordeaux mixture, which constitute an ordinary preventive measure against diseases in general, appear certainly to hold Phytophthora infestans in check.

Strains; Varietal Resistance

BERMUDA:

No research work has been carried out on the strains of Phytophthora infestans in Bermuda.

BRITISH WEST INDIES:

Jamaica: There is no information at hand on the number of strains of Phytophthora infestans existing in Jamica.

CUBA:

There must be at least two or perhaps three distinct strains of Phytophthora infestans in Cuba, since it has recently been noted that with temperature and weather conditions under which the old strain would not prosper, the disease seems to abate very little. Further, when late blight was first noted fairly good control could be effected with the coppers, something which is now not true.

DOMINICAN REPUBLIC:

Up to the present time, no work has been undertaken in the country in distinguishing different types of Phytophthora infestans.

REPUBLIC OF HAITI:

We have no data on the probable existence of different strains of fungi in Haiti. The varieties of tomatoes currently utilized in Haiti are "Marglobe" and "Oxheart", the seeds of which are imported each year from the U. S. As elsewhere, the position of the tomato with reference to problems posed up to now by Phytophthora infestans, does not appear at the moment to necessitate researches in Haiti concerning the strains of the microorganisms and varietal resisance of the hosts.

Bibliography:

* - Indicates references furnished by cooperators.
All others were taken from available literature.

*Alvarez-Garcia, L. A., J. Adsuar, J. P. Rodriguez, A. C. Miret, F. Arostegui, R. Olivencia, and F. Rochet. 1953. Fungicidal control of early and late blight of the potato in Puerto Rico. Jour. Agr. Univ. Puerto Rico 37: 288-297.

*Andreu, A. Martinez. 1951. La lucha contra las plagas. Publ. Ministerio de Agricultura Oficial, Direccion de Agricultura, Seccion de Sanidad Vegetal. 14 pp.

*Anonymous. 1947. La plaga que azoto recientemente las zonas tomateras. Pamphlet of Ferrocarriles Consolidados de Cuba, Camagüey.

Ashby, S. F. 1914. Reports on diseased specimens. Journ. Jamaica Agr. Soc. 18: 336-338.

_____. ? 1918. Report Jamaica Dept. Agr. 1917: 26-28.

*Baker, F. E. D. 1939. Notes on the diseases and fruit rots of tomatoes in the British West Indies. Trop. Agr. Trin. 16: 252-257.

Ciferri, R. 1927. Informe de fitopatologia. Principales enfermedades de las plantas cultivadas, observadas en el curso del ano 1926. [Report on phytopathology. Principal diseases of cultivated plants observed during the year 1926]. Segundo Informe Anual Estac. Nac. Agron. Moca, Republica Dominicana, 1926: 36-44.

_____. 1939. Phytopathological survey of Santo Domingo. 1925-1929. Jour. Dept. Agr. Porto Rico 14: 5-44.

Cook, M. T. 1939. Enfermedades de las plantas economicas de las Antillas.

Monografia Univ. Puerto Rico, Ser. B., no. 4: 1-530.

*Deschapelles, Jorge B. and Antonio Martinez Andreu. (undated). Tizon tardio en el tomate su control. Republica de Cuba, Ministerio de Agricultura, Direccion de Agricultura, Seccion de Sanidad Vegetal. [Mimeographed report].

Henricksen, H. C. 1906. Vegetable growing Porto Rico. Porto Rico Agr. Exp. Sta. (Mayaguez) Bull. 7. 58 pp.

Howitt, J. E. 1927. Phytophthora infestans causing damping-off of tomatoes. Phytopath. 7: 319.

Jehle, R. A. 1933. El tizon tardio y la pudricion de la papa. Bol. inform. agr. 21: 21-31.

Larter, L. N. H. 1940. Report of the plant pathologist. Ann. Rept. Jamaica Dept. Sci. and Agr. 1939-40. p. 22-23.

Martyn, E. B. 1942. Diseases of plants in Jamaica. Jamaica Dept. Sci. and Agr. Bull. (N.S.) 32: 34 p.

*Russell, T. A. 1935. Report of the Plant Pathologist, 1934. Bermuda, Report Department of Agriculture for the year 1934. p. 26-27.

*_____. 1936. Diseases and pests of tomatoes in Bermuda. Trop. Agr. Trin. 13: 71-78.

Smith, F. E. V. 1931. Plant diseases in Jamaica in 1930. Ann. Rept. Dept. Agr. Jamaica 1930. pp. 15-19.

_____. 1933. Some diseases of tomatoes in Jamaica. I. Jour. Jamaica Agr. Soc. 37: 131-135.

_____. 1933. Plant diseases in Jamaica in 1932. Report of the Government Microbiologist. Ann. Report. Dept. Sci. and Agr. Jamaica for the year ended 31st December, 1932. pp. 13-16.

Stevenson, John A. 1917. Diseases of vegetable and garden crops. Jour. Dept. Agr. Porto Rico 1: 93-117.

*Subirats, Fernando J. 1947. Amenaza el tizon tardio la zonas tomateras. Pamphlet of Ferrocarriles Consolidados de Cuba, Camagüey. 13 pp.

*_____. 1938. Cincuenta consejos para los cosecheros de tomate. Pamphlet of Ferrocarriles Consolidados de Cuba, Camagüey. 15 pp.

Thomas, H. E. 1918. Report of the Plant Pathologist. Report Porto Rico Agr. Exp. Sta. 1917. p. 28-30.

Trotman, A. E. 1951. Ann. Rept. Dept. Agr. Jamaica, for the year ended 31st March, 1951. 25 pp.

*Waterston, J. M. 1948. The fungi of Bermuda. Dept. Agr. Bermuda Bull. 23: 84.

Welles, Collin J. 1922. Plant diseases found at Trinidad in December, 1921. Phil. Agr. 10: 348-350.

Wright, J. 1950. Investigations 1948-49. Bull. Dept. Agr. Jamaica (N.S) 45. 110 pp.

_____. 1951. Investigations 1949-1950. Bull. Dept. Agr. Jamaica (N. S.) 47. 127 pp.

NORTH AMERICA
(including U. S. possessions in other areas)

First Report

CANADA:

First definite report of late blight of tomato in Canada was made in an anonymous report in 1916. It was recorded as "injuring the foliage and fruit of tomato in Ontario, but" ... "is the first record of its causing a damping-off of tomato plants."

However, as early as 1895 directions for spraying tomatoes (as well as potatoes) with Bordeaux mixture against "rot and blight" were published [Cf. Craig, John. 1895. Spraying for the prevention of fungous diseases. In Central Exp. Farm Agr. Bull. 23. p. 16].

MEXICO:

First record date unknown in Mexico.

UNITED STATES:

Found on tomatoes by H. W. Ravenel in September and October of 1859, in South Carolina (Cf. Farlow, W. G. 1876. Synopsis of the Peronosporeae of the United States. Peronospora. Bull. Bussey Institution 1: 426-429).

Ravenel also collected Phytophthora infestans on tomato at Aiken, South Carolina, March 1876 (specimen in National Fungus Collections, Beltsville, Maryland).

It was reported again in 1890 as attacking leaves of tomato plants so as to cause considerable damage and appearing in virulent form upon green and even partly ripe fruit. (Cf. Thaxter, Roland. 1891. Report of the Mycologist. In Annual Report of the Connecticut Agricultural Experiment Station for 1890. p. 95.)

GUAM:

No specific information available for Guam.

PUERTO RICO:

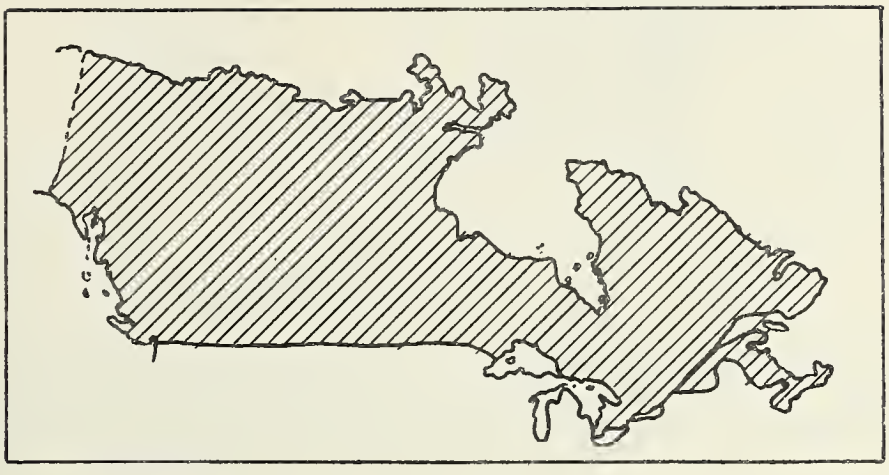
Late blight was first reported in Puerto Rican Experiment Station Bulletins by Henricksen, H. C. 1906. Vegetable growing in Porto Rico. Porto Rico Agric. Exp. Sta. (Mayaguez) Bull. 7 58 pp., illus.

TERRITORY OF HAWAII:

Late blight was first recorded for the Territory in 1918.

Distribution

CANADA:



Canada
(with the exception of northern islands and peninsulas; approx. 900 miles to the inch)

Tomato fruits affected by late blight have been received at Ottawa from every province in Canada, including Newfoundland.

In Table 1 are shown the reports of the occurrence of late blight on tomato as recorded in the Plant Disease Survey for the years 1922-1953. The disease is now known from every province in Canada.

In the 34 years since the Survey began, late blight has gradually extended its range until it may be found in all agricultural areas that are relatively contiguous except for an area in Alberta and Saskatchewan approximating closely the outline of the Palliser Triangle. These extensions have come during recurrent cycles of wet years.

Late blight was first recorded in Manitoba in 1927 (potato), in Alberta in 1943 (potato and tomato), and in Saskatchewan in 1946 (potato). The disease seems to have now established itself in Manitoba, but its hold on the British Columbia interior, Alberta, and Saskatchewan is tenuous.

The fact that the records of the occurrence of Phytophthora infestans on tomato follow so closely those on potato adds support to the view that only one organism is responsible for the disease on the two hosts. The larger number of reports of both diseases in recent years may be due in part to the greater number of observers. Undoubtedly, the use of the newer pesticides has greatly extended the life of the potato vines and increased the chances of the vines and tubers becoming infested. The use of southern-grown transplants in fields devoted to canning crops may have also had an effect.

There is some evidence that late blight became more destructive on tomato fruit beginning in 1940. If there was evidence of "potato" and "tomato" strains of P. infestans before that time, there is direct field evidence that potatoes are now infected by strains capable of causing great destruction to tomatoes.

Table 1. Reports from the Canadian Plant Disease Survey of late blight on tomato, 1922-1953.

Year	British Columbia	Alberta	Saskatchewan	Manitoba	Ontario	Quebec	New Brunswick	Nova Scotia	Prince Edward Island	Newfoundland	Remarks
1922							+			0	
1927							+			0	
1931							+			0	
1932									+	0	
1934	+								+	0	
1935						+				0	
1936							+		+	0	
1937	+									0	
1938									+	0	
1940	+				+		+			0	Severe in Ontario
1941	+				+	+	+		+	0	
1942					+	+				0	
1943		+		+	+	+	+	+	+	0	
1944				+	+	+	+		+	0	
1945				+	+	+	+	+	-	0	
1946					+	+	+		+	0	Severe in Ontario
1947	+				+	+	+	+	+	0	Severe in Ontario
1948	+			+	+	+	+	+	+	0	Severe in Ontario
1949					+			+	+		
1950	+			+	+	+	+	+	+		Severe in greenhouse crops in Ontario.
1951	+			+	+	+	+	+	+	+	
1952	+				+	+	+	+	+		
1953	+		+		+	+	+	+		+	Unpublished

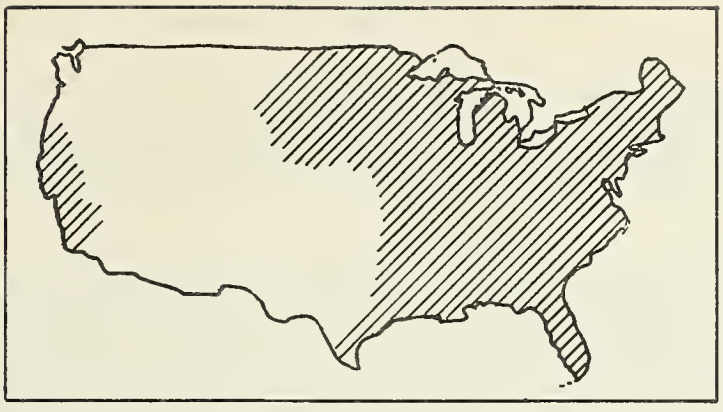
+ = reported present.
- = reported not present.

MEXICO:

The present known distribution of tomato late blight in Mexico has not been charted; it is known to exist along the coast of the Gulf of Mexico and the Bay of Campeche and in the southcentral part of the country.

Mexico
(World Mercator Proj.
approx. 500 miles to the inch)

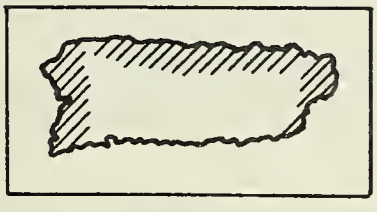
UNITED STATES:



United States
(approx. 900 miles to the inch)

Tomato late blight is distributed in the New England States and can be found in certain sections of the Middle Atlantic, south central, and South Atlantic States. Occasionally it has been reported in some sections on the Pacific Coast. Recently it has been found in several mid-western and north central States (see also under Spread).

PUERTO RICO:

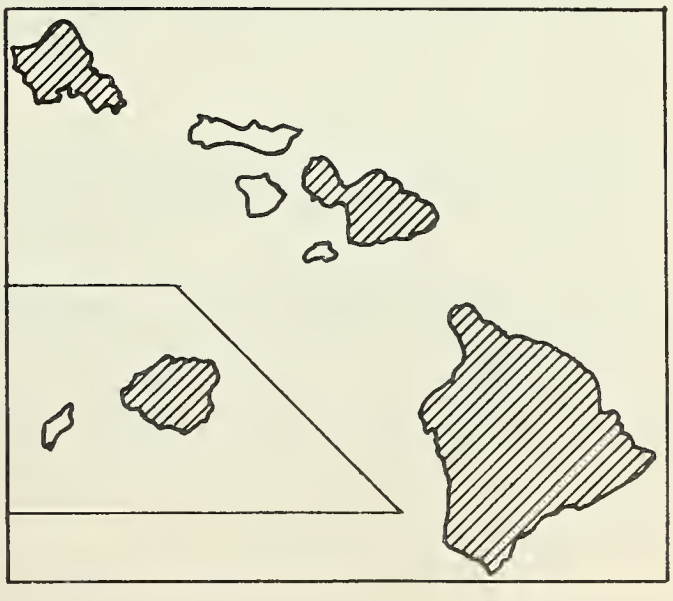


Puerto Rico
(approx. 137 miles to the inch)

Tomato late blight is endemic in Puerto Rico and occurs frequently in the mountainous areas and in the northern, western, and eastern coastal plains where rainfall is abundant.

TERRITORY OF HAWAII:

Late blight is known to occur on the four largest islands of the Hawaiian group; namely, Hawaii, Maui, Oahu, and Kauai.



Territory of Hawaii
(Mercator Proj.
434 miles to the inch)

Spread; Environmental and Geographic Factors Involved; Potential Danger Spots

CANADA:

The disease is believed to be spread by wind-borne spores. The source of inoculum in Canada is probably potato cull piles although reports of infection from southern-grown transplants are known.

MEXICO:

Principal means of spread appear to be winds. The geographical contours of the country (high mountain ranges) which isolate numerous valleys appear to limit or at least influence tremendously its distribution.

Potential danger spots include the tomato-growing region near Ciudad Valles and El Mante. Because of the late blight problem and other foliage diseases, tomatoes are not cultivated to any great extent in the high valleys where late blight could be very severe.

UNITED STATES:

The most recent advance in the distribution of tomato late blight in the United States has occurred within the past few years. In 1950 it spread on tomatoes westward into Arkansas, Missouri, Iowa, and Nebraska and in 1951 continued its northwestward movement across the upper tier of north central States.

Environmental factors contributing to this spread include: the existence of potato dump piles near tomato fields; appearance of blight on volunteer potato plants; gradual spread of blight from field to field by airborne spores; and the transfer of infection from one part of the country to another on southern-grown transplants affected with blight. In 1950 the weather conditions were extremely favorable for the development of blight. In the affected areas, mostly in the eastern to midwestern portions of the country, a warm winter, followed by a cool spring and warm-wet early summer with a cool-wet midsummer, provided the ideal conditions for blight development. Blight spreads most rapidly during damp weather when temperatures do not go much above 70°F.

Neighboring blight-infected potato fields, blight-infected tomato transplants from the South, and infected potato cull piles are potential dangerous sources of tomato blight outbreaks.

PUERTO RICO:

The principal means of spread are wind, splashing rains, and run-off water. Also, low temperatures (16-20°C.) during the fall and winter months and abundant rainfall or water of condensation favor infection.

The topography of the land has some influence. In the mountainous areas the temperature is lower during the longer periods than in the coastal plains; therefore, the disease is spread over more months. On the south coast the relatively scanty rainfall per year (40 inches) and the dry winds are factors moderating the incidence and spread of the disease. However, under irrigation blight can be serious if the temperature and atmospheric humidity surrounding the tomato plants favor the development of the disease. In the Isabela district, under irrigation, late blight has been serious some years.

TERRITORY OF HAWAII:

Airborne spores are probably the chief means of spread from farm to farm within each of the islands, which are separated by distances ranging from 80 to 200 miles or so.

Infected volunteer plants growing the year round in the cooler, wet areas could serve as likely sources of spread, also.

The potential danger spots where a severe outbreak could occur are those in the higher elevation areas (1,500 to 3,000 feet). These areas are located on Maui and Hawaii.

Damage

MEXICO:

In severe blight years, we would estimate that damage is practically 100 percent; in years of moderate infection, probably 35 percent. These figures are not much more than guesses, but we hope to have more specific information in the future.

UNITED STATES:

Isolated epidemics, occurring in various parts of the tomato-growing areas of the country, have been reported, one as early as 1905 in Massachusetts. However, it was in 1946 that an unprecedented epidemic of late blight occurred in the eastern one-third of the country and caused an estimated $40,000,000 loss in tomatoes. The South Atlantic Seaboard States experienced the heaviest attack with losses exceeding 50 percent. In 1950 tomato late blight was again of economic importance, attacking sizeable acreages and affecting the marketability of the crop. Estimated percent reduction in yield of these infected acreages varied from a trace to 95 percent. Severity and loss equalled or possibly exceeded that suffered from the destructive 1946 outbreak. In many cases untreated fields were completely destroyed. It was in this year that the disease moved westward and appeared in States where it had never been reported previously.

PUERTO RICO:

In severe blight years, complete loss of crops has been experienced. Estimates for losses during years of moderate infection are conflicting. A fair guess would be 10 to 30 percent.

TERRITORY OF HAWAII:

In severe years up to 30 percent loss has been observed, but previous workers have indicated more serious defoliation.

In years of moderate infection a 10 to 20 percent loss in yield has been observed.

Control Measures; Effectiveness of These Measures

CANADA:

Control measure suggested at the present time is a spray schedule involving an organic fungicide such as ziram or Manzate for the first applications during that part of the season when late blight does not threaten. Bordeaux mixture or a fixed copper is recommended for the control of blight. These measures are quite effective where applications are thorough and timely.

MEXICO:

Control measures recommended include the use of Bordeaux mixture and Copper A. No doubt in the Mante region other fixed coppers are used and recommended, but we know very little of this work and are not able to report on the effectiveness of such sprays.

UNITED STATES:

Good, standard cultural practices are recommended in the control of tomato late blight. These include the use of strong, disease-free tomato plants. These plants should not be crowded in planting for when planted too close together, the foliage dries out slowly after rains and heavy dews and affords excellent conditions for attack by late blight. Six feet should be allowed between rows with 3 feet between plants in the row.

Late blight can be controlled by spraying with Bordeaux mixture, usually at the rate of 8 pounds copper sulfate and 4 pounds of lime to 100 gallons of water. However, it is not recommended for tomato seedlings. Also, successful control can be obtained by spraying with a fixed copper fungicide. These fixed, or insoluble, copper compounds include copper oxychloride sulfate, basic copper sulfates, copper oxychloride, and copper oxide. They are generally proprietary compounds sold under trade names. Since these compounds do not contain lime, they

usually cause less injury to the plant and are recommended for seedbed spraying. As field sprays they are usually prepared on the basis of 2 pounds copper (calculated as metallic copper) to 100 gallons of water.

Good control has been obtained by spraying with disodium ethylene bisdithiocarbamate (Dithane D-14) used with zinc sulfate and lime, 2 qts.-1-1/2-100.

Another product, closely related to zinc sulfate reaction product of Dithane D-14, is zinc ethylene bisdithiocarbamate (Dithane Z-78, Parzate) which has given good control for late blight. The addition of zinc sulfate or lime is not required. Application should be made according to the directions of the manufacturer..

Spraying is preferred by most growers to dusting. However, fixed copper dusts are effective if properly applied. Sprays should be applied at intervals of 5 to 10 days, depending on the weather; for dusts the time lapse should be 7 days.

Since 1947 a Plant Disease Warning Service has been conducted by the Plant Disase Epidemics and Identification Section (formerly Mycology and Disease Survey Division) of the U. S. Department of Agriculture. Through timely and pertinent reports, based on material on the late blight situation sent in by collaborators in the States and Canada, farmers, growers, farm equipment and fungicide companies are warned of the presence or absence of disease in their areas. This permits the allocation of fungicides or equipment to sections most in need of spraying or dusting materials or machinery. It also warns the grower of the possibility of an impending attack and affords him the opportunity to prepare for it by the use of proper control measures. In the absence of late blight the grower need not spray, thus saving himself time, money, and energy.

PUERTO RICO:

Spraying with Bordeaux, Dithane D-14, Dithane Z-78, Parzate, Copper A compounds weekly in seedbeds and in the field has been recommended. These treatments often mean the difference between success or failure and have contributed to increased production in the tomato areas of Jayuya, Villalba, and Isabela.

Some growers report that the use of open-growing types is important and they also employ cultural practices that encourage aeration. This undoubtedly assists in obtaining good coverage with sprays.

TERRITORY OF HAWAII:

Formerly, fixed coppers were generally recommended and gave good late blight control, but more recent tests in 1952 showed Manzate to be superior to any other spray treatment. Consequently, many growers are using Manzate successfully. In 1952 spray test evaluations were made on late blight control. The descending order of control was Manzate, Tribasic, zineb, yellow cuprocide, ziram, and check.

Strains; Varietal Resistance

CANADA:

There is no evidence of "potato" and "tomato" strains of Phytophthora infestans in Canada although some isolates of the fungus are more aggressive on one host than on the other. We designate a common race 1 or 0 which attacks tomatoes and potatoes. A second, now labelled as tomato race 2, attacks selections of Lycopersicon esculentum var. cerasiforme that carry a single gene for resistance to Race 1. No commercial varieties of L. esculentum carry any tangible degree of resistance. Race 2 has been isolated from potatoes as well as tomatoes.

Race 1 or 0 is the most widespread, while Race 2 has been isolated from tomato fruits sent in from Essex and Carleton Counties, Ontario, It is not known to occur on tomatoes in Quebec and the Maritime Provinces. Only Race 1 has been isolated from material sent in from the western provinces.

As Race 2 seems limited in distribution, efforts have been concentrated on the incorporation of the available resistance to Race 1 into commercial tomatoes. So far, this resistance, of the hypersensitive, necrotic lesion type, has persisted to the second backcross to a commercial variety.

MEXICO:

No work has been done on strain study of the tomato late blight.

Varietal host resistance appears to exist in several wild tomato collections which have been made.

UNITED STATES

Study of the race problem in Phytophthora infestans in the United States has produced conflicting results.

After five seasons of inoculation experiments, Berg (1926) maintained that the potato and tomato strains of the fungus were biologically distinct. This appears to be the first record of biotypes in P. infestans. In 1933 Reddick's and Crosier's (see Bibliography) experiments and observations revealed no biological specialization among various isolates and they came to the opinion that there was only one biotype of P. infestans distributed throughout the U. S. and that this type was similar to the one found in Europe by Schick. They attributed Schick's (1932) results in Pomerania, where his experiments actually demonstrated the existence of three forms, to the introduction of Solanum demissum gene resistance which made variants more readily discernible, or to a new form arising from the germination of viable oospores. Later, Mills and Peterson (1949) showed that S. demissum was immune to all known races of P. infestans and that several genes were concerned in the resistance.

Mills (1940) has shown that the tomato strain is derived from potatoes and, although at first weakly parasitic on tomato, rapidly increases in virulence as it becomes adapted to life on tomato foliage by serial passage through this latter host. In cross inoculation studies Waggoner and Wallin (1952) demonstrated the existence of a tomato race and a potato race. These two races were equally pathogenic to potato but differed somewhat in development on tomato. The races were most often isolated from their specific hosts but each could also be isolated from the other host. Hyre (1949) suggested that there is only one tomato race of P. infestans and that the potato strain affects tomatoes in a minor way. Gallegly (1952) has presented experimental evidence to show that there are at least three races of the late blight organism pathogenic to tomato. Some wild hosts of tomato showed resistance to late blight, whereas no commercial varieties showed any resistance. In 1954 Gallegly and Marvel showed that there are two types of resistance to tomato race 1, the first controlled by a single dominant gene and the second derived from multiple genes.

It is hoped that further studies, both here and abroad, will eventually determine the existence and number of strains of P. infestans pathogenic on tomato.

Since the race picture is not entirely clarified and since many of our contributors mentioned the work done principally on potatoes in their countries on strains which were classified according to the International Designation for races of P. infestans, we include a chart of the International System of Designating Interrelationships of Genes and Races. This was primarily set up to classify the resistance of potato to races of P. infestans.

PUERTO RICO:

Race A has been identified.

TERRITORY OF HAWAII:

There has been very little work done here on strains of the late blight fungus although Hendrix reported in our [The Hawaii Agricultural Experiment Station] 1946-48 biennial report, p. 157: "Late blight resistance, for the strain of the organism occurring in Hawaii, has not been found in any tomato line tested. Plants of lines reported to have a promising degree of tolerance on the mainland have thus far been killed by late blight in tests... at Makawao, Maui. There have been no local varieties developed that are resistant to late blight."

INTERNATIONAL SYSTEM OF DESIGNATING INTERRELATIONSHIPS OF GENES AND RACES

GENOTYPE				RACES OF *P. infestans*															
Scotland				A	B^1	H	J	D	G	E	B^2	–	C	I	–	–	F	–	–
U.S.A.				A	D	C	–	B	–	–	BD	–	BC	–	–	–	–	–	–
Holland				N1	N2	N5	–	N4	–	–	N7	–	N6	–	–	N8	–	N9	–
International*				0	1	2	3	4	12	13	14	23	24	34	123	124	134	234	1234
r	r	r	r	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
R_1	D	R_9	R_1	–	S	–	–	–	S	S	S	–	–	–	S	S	S	–	S
R_2	C	R7	R_2	–	–	S	–	–	S	–	–	S	S	–	S	S	–	S	S
R_3	–	R_8	R_3	–	–	–	S	–	–	S	–	S	–	S	S	–	S	S	S
R_4	B	$R_{2,5}$	R_4	–	–	–	–	S	–	–	S	–	S	S	–	S	S	S	S
R_1R_2	CD	–	R_1R_2	–	–	–	–	–	S	–	–	–	–	–	S	S	–	–	S
R_1R_3	–	–	R_1R_3	–	–	–	–	–	–	S	–	–	–	–	S	–	S	–	S
R_1R_4	BD	–	R_1R_4	–	–	–	–	–	–	–	S	–	–	–	–	S	S	–	S
R_2R_3	–	–	R_2R_3	–	–	–	–	–	–	–	–	S	–	–	S	–	–	S	S
R_2R_4	BC	–	R_2R_4	–	–	–	–	–	–	–	–	–	S	–	–	S	–	S	S
R_3R_4	–	–	R_3R_4	–	–	–	–	–	–	–	–	–	–	S	–	–	S	S	S
$R_1R_2R_3$	–	–	$R_1R_2R_3$	–	–	–	–	–	–	–	–	–	–	–	S	–	–	–	S
$R_1R_2R_4$	BCD	–	$R_1R_2R_4$	–	–	–	–	–	–	–	–	–	–	–	–	S	–	–	S
$R_1R_3R_4$	–	–	$R_1R_3R_4$	–	–	–	–	–	–	–	–	–	–	–	–	–	S	–	S
$R_2R_3R_4$	–	–	$R_2R_3R_4$	–	–	–	–	–	–	–	–	–	–	–	–	–	–	S	S
$R_1R_2R_3R_4$	–	–	$R_1R_2R_3R_4$	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	S

* Races (2,3), (1,2,3) and (1,2,3,4) are hypothetical at present.

– = Resistant S = Susceptible

Bibliography:

* - Indicates references furnished by cooperators.
All others were taken from available literature.

*Anonymous. 1916. Damping-off of tomatoes. In Ont. Agr. Coll. & Exp. Farm Ann. Rept. 42. p. 16.

Berg, Anthony. 1926. Tomato late blight and its relation to late blight of potato. West Virginia Agr. Exp. Sta. Bull. 205: 1-31.

Bisby, G. R., et al. 1938. "The fungi of Manitoba and Saskatchewan". Ottawa, Canada.

Carpenter, C. W. 1919. Report of the Plant Pathologist. Hawaii Agr. Exp. Sta. Rept., 1918.

Chester, K. Starr. 1950. Forecasting plant disease outbreaks and losses. In Plant disease losses: their appraisal and interpretation. Plant Dis. Reptr. Suppl. 193: 327-333.

Cook, H. T. 1949. Forecasting late blight epiphytotics of potatoes and tomatoes. Jour. Agr. Res. 78: 545-563.

*Craig, John. 1895. Spraying for the prevention of fungous diseases. In Central Exp. Farm Agr. Bull. 23. p. 16.

Crosier, W. 1934. Studies in the biology of Phytophthora infestans (Mont.) de Bary. New York (Cornell) Agr. Exp. Sta. Mem. 155. 40 pp.

Doolittle, S. P. 1943. Tomato diseases. U. S. Dept. Agr. Farmers' Bull. 1934. 83 pp. [See p. 31-32.].

_____ and R. J. Haskell. 1947. Late blight of tomatoes. U. S. Dept. Agr., Agr. Inform. Ser. 63.

Ellis, D. E. and H. R. Garriss. 1950. Control tomato late blight. North Carolina Agr. Ext. Serv. Circ. 331 (revised). 10 pp.

Farlow, W. G. 1876. Synopsis of the Peronosporeae of the United States. Peronospora. Bull. Bussey Institution 1: 426-429.

Ferguson, W., L. H. Lyall, and H. N. Racicot. 1952. Tomato breeding for resistance to Phytophthora infestans (Mont.) D By. I. Method of inoculation and preliminary results. Sci. Agr. 32: 57-66.

*Fletcher, James. 1893. Report of the Entomologist and Botanist. In Canada Dept. Agr. Exp. Farms Repts. (1892). p. 161.

*_____. 1895. Potato blights. In Central Exp. Farm Dept. Agr. Bull. 23. p. 25.

Frazier, W. A. and J. W. Hendrix. 1948. Other tomato disease resistance problems. Rept. Univ. Hawaii Agr. Exp. Sta. for the biennium ending June 30, 1948. p. 157.

Gallegly, M. E. 1952. Physiologic races of the tomato late blight fungus. Phytopatn. 42: 461-462.

_____ and M. E. Marvel. 1954. Inheritance of resistance to tomato late blight. Phytopath. 44: 489. (Abst.).

Giddings, N. J. and A. Berg. 1919. Comparison of late blights of tomato and potato. Phytopath. 9: 209-210.

Harrison, A. L. 1947. The relation of weather to epiphytotics of late blight on tomatoes. Phytopath. 37: 533-538.

_____. 1947. The control of late blight in tomato seed-beds under epiphytotic conditions. Phytopath. 37: 625-634.

Henricksen, H. C. 1906. Vegetable growing in Porto Rico. Porto Rico Agr. Exp. Sta. (Mayaguez) Bull. 7. p. 55.

Hyre, R. A. 1949. A survey of the occurrence of the races of Phytophthora infestans in northeastern United States. Plant Dis. Reptr. 33: 177-179.

_____. 1950. Trapping sporangia as an aid in the forecasting of several downy mildew type diseases. In Plant disease forecasting: a symposium. Plant Dis. Reptr. Suppl. 190: 14-18.

_____. 1954. Progress in forecasting late blight of potato and tomato. Plant Dis. Reptr. 38: 245-253.

Lavalée, E. ?1948. Mildiou des tomates. Résultats d'essais de pulvérisation en 1944. [Tomato blight. Results of spraying tests in 1944]. Rept. Québec Soc. Prot. Pl. 1945-1947. pp. 44-47.

Leonian, L. H. 1925. Physiological studies on the genus Phytophthora. Amer. Jour. Bot. 12: 444-498.

_____. 1927. The effect of different hosts upon the sporangia of some Phytophthoras. Phytopath. 17: 483-490.

_____. 1934. Identification of Phytophthora species. West Virginia Agr. Exp. Sta. Bull. 262. 36 pp.

Linn, M. B. 1950. Tomato blight, its origin and control. Canner, 111, 23: 11-13.

_____. 1951. Sources of tomato late blight and suggestions for control. Canner, 113, 19: 12.

Martin, W. J. 1949. Strains of Phytophthora infestans capable of surviving high temperatures. Phytopath. 39: 14. (Abst.).

*McCubbin, W. A. 1918. The diseases of tomatoes. Canada Dept. Agr. Bull. 35, 2nd ser. p. 12.

Melhus, I. E. 1915. Germination and infection with the fungus of the late blight of potato (Phytophthora infestans). Wisconsin Agr. Exp. Sta. Res. Bull. 37. 64 pp.

Miller, Paul R. and Muriel O'Brien. 1952. Plant disease forecasting. The Bot. Rev. 18: 547-601.

_____. 1954. The role of the Plant Disease Survey in forecasting plant diseases. Indian Phytopath. (in press).

Mills, W. R. 1940. Phytophthora infestans on tomato. Phytopath. 30: 830-839.

_____. 1947. Tomato race of late blight overwintering on potato tubers in Pennsylvania. Plant Dis. Reptr. 31: 230.

_____ and L. C. Peterson. 1949. Potato blight investigations. Amer. Pot. Jour. 26: 98. (Abst.).

_____ and _____. 1952. The development of races of Phytophthora infestans (Mont.) de Bary on potato hybrids. Phytopath. 42: 26. (Abst.).

O'Brien, Muriel and Paul R. Miller. 1949. A review of monthly weather conditions in relation to tomato late blight incidence. Plant Dis. Reptr. 33: 172-176.

*Panton, J. H. 1892. Fungicides and insecticides. Ont. Agr. Coll. Exp. Sta. Bull. 23. p. 3.

*_____. 1897. Instructions in spraying. Ont. Agr. Coll. Exp. Sta. Farm Bull. 105. p. 6.

Ramirez, R. 1921. Plagas de la agricultura en el distrito federal. [Agricultural pests in the Federal district]. La Revista Agricola (Mexico) 5: 662-663.

_____ and Julio Riquelme Inda. 1911. La enfermedades del jitomate. Bol. de la Est. Agricola Central (Mexico) 56: 1-46.

Ramsey, G. B. 1931. Tomato late-blight rot, a serious transit and market disease. U. S. Dept. Agr. Circ. 169. 11 pp.

Reddick, D. and W. Crosier. 1933. Biological specialization in Phytophthora infestans. Amer. Pot. Jour. 10: 129-134.

Richardson, Jr., R. W. and H. Oscar Brauer. 1954. Verduras en el huerto familiar. Mex. Ofic. de Estud. Espec. Fol. de Divulg. No. 16. 79 pp.

Rios, G. Mario. 1951. Aspersiones en el jitomate en Chapingo, Mexico, 1949. Mex. Ofic. de Estud. Espec. Fol. Misc. 4: 154-157.

Rosenbaum, J. 1917. Studies of the genus Phytophthora. Jour. Agr. Res. 8: 233-276.

Schick, R. 1932. Über das Verhalten von Solanum demissum, Solanum tuberosum und ihren Bastarden gegenüber verschiedenen Herkünften von Phytophthora infestans. (Vorläufige Mitteilung zur Frage der biologischen Spezialisierung von Phytophthora infestans). Der Züchter 4: 233-237.

Stevens, F. L. 1925. Hawaiian fungi. Bernice P. Bishop Mus. Bull. 19. 189 pp.
Stevenson, John A. 1917. Diseases of vegetable and garden crops. Jour. Dept. Agr. Porto Rico 1: 93-117.
Thaxter, R. 1889. A new American Phytophthora. Bot. Gaz. 14: 273-274.
_____. 1891. Report of the Mycologist. In Annual Report, Connecticut Agr. Exp. Sta. for 1890. p. 95.
Tucker, C. M. 1931. Taxonomy of the genus Phytophthora de Bary. Missouri Agr. Exp. Sta. Res. Bull. 153. 208 pp.
Waggoner, Paul E. and J. R. Wallin. 1952. Variation in pathogenicity among isolates of Phytophthora infestans on tomato and potato. Phytopath. 42: 645-648.
Wallin, J. R. 1953. The production and survival of sporangia of Phytophthora infestans on tomato and potato plants in the field. Phytopath. 43: 505-508.
_____ and R. W. Samson. 1952. Forecasting late blight in Indiana from mean temperature and cumulative rainfall data. Phytopath. 42: 482. (Abst.).
_____ and R. H. Shaw. 1953. Studies of temperature and humidity at various levels in crop cover with special reference to plant disease development. Iowa State Coll. Jour. Sci. 28: 261-267.

SUMMARY IN ENGLISH AND INTERLINGUA

WHAT "INTERLINGUA" IS

For those who may not be familiar with "Interlingua", it is one of over 300 international languagues which have been invented during the last century. The vocabulary is derived from Latin, Italian, Spanish, Portuguese, French, English, German, and Russian. It embodies all the word material that the languages of the Western World have typically in common. The troublesome intricacies of grammar have been discarded. There is only one verb form in each tense, and nouns, adjectives and verbs do not have to agree as is the case with more complex languages. Many will find the Interlingua vocabulary basically familiar to them because the scientific words generally are either derived from English roots when these are common to other languages or are taken from the Romance languages. Further information with regard to Interlingua can be obtained from Dr. Alexander Gode, Science Service, Division de Interlingua, 80 East Eleventh Street, New York 3, New York.

QUE ES INTERLINGUA?

Pro le information de personas non familiar con interlingua: Le vocabulario de iste plus recente inter alicun 300 linguas international proponite in le curso del passate seculo es derivate ab latino, italiano, espaniol, portugese, francese, anglese, germano, e russo. Illo incorpora omne le elementos linguistic que se trova typicamente in commun in le linguas del mundo occidental. Le enoiose complexitates grammatic ha essite eliminate. Interlingua possede un sol forma verbal in cata tempore, e substantivos, adjectivos, e verbos non exhibi ulle accordo grammatic (como il es le caso in le linguas plus complicate). Multe personas trovara que le vocabulario de interlingua es basicamente familiar a illes proque le formas de terminos scientific in ille idioma es derivate ab radices del linguas roman que etiam occurre in anglese.

Informationes additional in re interlingua es obtenibile ab Dr. Alexander Gode, Science Service, Division de Interlingua, 80 East Eleventh Street, New York 3, New York.

SUMMARY

This paper presents a study of Phytophthora infestans (Mont.) D By. on Lycopersicon esculentum L., including records of first-reported occurrence of tomato late blight, its distribution, spread, the damage it causes, control measures applicable, and the existence and number of strains of the fungus. Data were obtained on a world-wide basis. Reports are given for 28 countries and territories in Europe, 29 in Africa, 11 in Asia, 9 in the Australasian area, 10 in South America, 5 in Central America, 7 in the Caribbean area, and all of North America.

First appearance records show that late blight was reported on tomato for the first time as early as 1843 and as recently as 1954. Recent first reports are concentrated in Africa.

Late blight of tomato is world-wide in its distribution.

Spread under natural condtiions is governed usually by local environmental factors, including proximity to blighted potatoes, endemic spots, and infected nursery seedbeds. Weather conditions affecting the spread of late blight are wind, rain, high humidity, and temperatures not in excess of 70°F. Of particular interest is the recent appearance of late blight on tomato in areas where it had previously never been found, i. e. in parts of Africa heretofore free from the disease and some midwestern and north-central States of the United States.

The damage reported varies widely, and estimates of losses range from very slight to total destruction in years of severe epidemics.

Bordeaux mixture is a universally employed control measure. Other copper compounds are also used as well as the newer organic fungicides.

Races in Phytophthora infestans have not been investigated as yet in some areas. In several countries such studies are being made although many are concerned primarily with the strains of the fungus on potato. However, in several countries several biotypes on tomato have been determined.

Distribution maps are given in each continental section.

SUMMARIO IN INTERLINGUA

Iste articulo presenta un studio del fungo Phytophthora infestans (Mont.) D By. super Lycopersicon esculentum L., i. e. del morbo que es cognoscite como "peste tardive del tomate." Le studio coperi le tempore del prime reportos del peste, su distribution, su expansion, le damnos causate per illo, le mesuras usate in le lucta contra illo, e le existentia e le numero de stirpes del fungo in question. Le datos includite proveni ab omne partes del mundo: 28 paises e territorios de Europa, 29 de Africa, 11 de Asia, 9 del area australasian, 10 de Sud-America, 5 de America Central, 7 del area caribe, e Nord-America integre.

Le datos in re prime occurrentias indica que le pesta tardive de tomates esseva primo reportate jam in 1843 e ancora in 1954. Recente prime reportos es concentrate in Africa.

Le peste tardive del tomate ha un distribution mundial.

Sub conditiones natural su expansion depende normalmente de factores del ambiente local. Istos include le proximitate de patatas infestate, de locos endemic, e de inficite seminarios. Le factores meteorologic que es de importantia in le diffusion del peste tardive es vento, pluvia, alte humiditate, e temperaturas non excedente 21°C. Un observation de interesse special es le apparition in tempores recente de peste tardive del tomate in areas ubi illo habeva nunquam essite trovate previemente, i. e in certe areas de Africa e in alicun statos del medie-west e del nord central del Statos Unite.

Le damnos reportate varia grandemente. Estimationes del perditas suffrite coperi le integre spectro ab "levissime" a "destruction total" in annos de sever epidemias.

Un contra-mesura de uso universal es mixtura bordelese. Altere compositos de cupro es equalmente in uso e etiam le plus recente fungicidas organic.

Le racias de Phytophthora infestans es nondum investigate in alicun areas. In plure paises tal studios es in progresso ben que multes es primarimente concernite con le stirpes del fungo que occurre super patatas. Nonobstante, in plure paises plure biotypos occurrente super tomates ha essite identificate.

Mappas distributional es providite in le articulo pro cata section continental.

COMMON NAMES USED IN VARIOUS COUNTRIES FOR LATE BLIGHT*

Common Name	Host	Language	Reference
Aardappelziekte (potato blight)	Potato	Dutch	Landbouwk. Tijdschr. 63: 77. 1951.
Blight of potato	Potato	English	Emp. Journ. Exp. Agric. 17: 238. 1949.
Eki-byo	Potato Tomato	Japanese	Nuttonson, M. Y. 1952. Ecological crop geography and field practices of the Ryukyu Islands, natural vegetation of the Ryukyus, and agroclimatic analogues in the Northern Hemisphere. American Institute of Crop Ecology, Washington, D. C. p. 94.
Hielo (potato blight)	Potato	Spanish	Bol. Estac. Exp. Agric. No. 39, La Molina, Peru. 1950. Peru. Segura, C. Bazán de. Principal enfermedades de las plantas en el Peru. Bol. Estac. Exp. Agric. No. 51, La Molina, Peru. 1953.
Irish blight	Potato Tomato	English	Queensl. Agr. Jour. 60: 279. 1945.
Kartoffelskimmel	Potato	Danish	Statens Plantepatolog. Forsøg Maanedsoversigt over Plantesydomme 321: 99-109. 1951.
Knollenfäule der Kartoffel	Potato	German	Pflanzenschutz 2: 13. 1950.
Krautfäule	Potato	German	Nachrichtenbl. Deutsch. Pflanzenschutzd. (Braunschweig) 3: 104-108. 1951.
Late blight of potato	Potato	English	Australian Pl. Dis. Rec. 2: 30. 1950.
Mancha Negra	Tomato	Spanish	Mex. Sec. de Agr. y Ganaderia Ofic. de Estud. Esp. Foll. Misc. 4: 154. 1951.
Mildiou de la pomme de terre	Potato	French	Parasitica 5: 89. 1949.
Mildiyõ	Potato	Turkish	Bitki Koruma Bull. 1952. (4): 25.
Peronospora	Potato	Italian	Boll. della Staz. di Patol. Veg. 8: 262-264. 1950 (1952).
Plamenjača	Potato	Croatian, Serbian	Cuturilo, S. 1952. Zastita Bilia 11: 27-41. Stojanovic, D., Panjanin, M. et al. Diseases and enemies of cultivated plants 213 pp. 1951.

* Compiled by Bernard R. Lipscomb

Common Name	Host	Language	Reference
Plijesan	Potato Tomato	Croatian	Biljna Proizvodnja 6: 39, 42. 1953
Plízeň Bramborová	Potato Tomato	Czechoslovakian	Ochrana Rostlin 17: 21-34. 1941.
Potatisbladmögel	Potato	Swedish	Växtskyddsnotiser, Växtskyddsanst., Stockh. 1950: 19. 1950.
Rancha	Potato	Spanish	Segura, C. Bazán de. Principal enfermedades de las plantas en el Peru. Bol. Estac. Exp. Agric. No. 51, La Molina, Peru. 1953.
Requeima	Potato Tomato	Portugese	Biológico 17: 179-188. 1951. [Brazil].
Tomatenfruchtfäule	Tomato	German	Nachrichtenbl. Deutsch. Pflanzenschutzd. (Braunschweig) 3: 104-108.
Tizon Tardio	Tomato	Spanish	Mex. Sec. de Agr. y Ganaderia Ofic. de Estud. Esp. Foll. Misc. 4: 154. 1951.
Zaraza Ziemniaczana	Potato	Polish	Zablocka, W. Grzyby Pasozytne. 79 pp. Warsaw.

HERBARIUM RECORDS

Phytophthora infestans (Mont.) de Bary on Lycopersicon esculentum L.

NATIONAL FUNGUS COLLECTIONS, BELTSVILLE, MARYLAND.

Mayaguez, P. R., May 15, ?1907; coll. H. C. Henricksen.
May 8, 1917; coll. J. A. Stevenson and H. E. Thomas.
Maricao, P. R., March 16, 1916; coll. H. H. Whetzel and Edgar W. Olive.
Turrialba, Costa Rica, Jan. 1, 1947 and Jan. 10, 1949; coll. F. L. Wellman.
Chimaltenango, Guatemala, Oct. 8, 1941; coll. A. S. Muller.
Königstein, Germany, Sept. 1910; W. Krieger, Fungi saxonici.
Reduit, Mauritius, Sept. 1923; coll. E. F. S. Shepherd.
Mauritius, June, 1925; coll. E. F. S. Shepherd.

COMMONWEALTH MYCOLOGICAL INSTITUTE, KEW, ENGLAND.

Mauritius -- Herb. I.M.I. 27,886.
British Cameroons -- Herb. I.M.I. 53,090.

ADDENDA

The following reports were received after this manuscript was prepared and ready for multilithing:

ETHIOPIA:

Late blight of tomato has not been seen in the Jimma area and to our knowledge nowhere in Ethiopia although it is reported in most of the adjacent countries and very likely will be found here sooner or later.

MOROCCO:

Important outbreaks of tomato late blight have occurred within 15 to 18 days following rains in January and February, 1955. Plants at every stage of growth, from seedlings to one- to four-month old transplants, were attacked even after the use of fungicides in a once or twice weekly spray schedule. Many farmers, however, did not spray at all in the rainy periods.

Also, in September, 1954, a late planting of tomato was partly wiped out by an outbreak of blight occurring after several foggy days without rain.

BELGIAN CONGO:

The laboratory at Mulungu has little information on the development of Phytophthora infestans on tomato.

The first record of occurrence dates from 1951 at Kivu where the disease is widespread.

One of the greatest difficulties has been in the control of the fungus. Many of the varieties sent to us as immune to the disease have not proven to be resistant under our local conditions. Copper fungicides have little effect in controlling the disease. Frequent application of derivatives of dithiocarbamic acid, particularly Zerlate and Manzate, appears to be much more efficacious. Treatment which planters are advised to follow at the present time is the alternate use of Zerlate or Manzate and oleo-copper.

LIST OF CONTRIBUTORS

Europe

AUSTRIA:
Dr. Beran, Bundesanstalt für Pflanzenschutz, Trunnerstrasse 5, Wien II/27.

DENMARK:
Dr. Børge Jacobsen, Director, Potato Breeding Institute, Vandel.

ENGLAND:
Dr. A. Beaumont, National Agricultural Advisory Service, Ministry of Agriculture and Fisheries, Government Buildings, Lawnswood, Leeds 6.
Dr. W. C. Moore, Director, Plant Pathology Laboratory, Ministry of Agriculture and Fisheries, Milton Road, Harpenden, Herts.
Dr. S. P. Wiltshire, Director, Commonwealth Mycological Institute, Ferry Lane, Kew, Surrey.
[To Dr. Wiltshire we are indebted for information concerning several areas of the British Empire.]

FINLAND:
Dr. J. E. Hårdh, Dept. of Plant Pathology, Agricultural Research Center, Tikkurila.

GERMANY:
Dr. H. Müller, Biologische Bundesanstalt für Land-und Forstwirtschaft, Messeweg 11/12, Braunschweig (20b).

IRELAND: See under Northern Ireland and the Republic of Ireland.

ITALY:
Dr. R. Ciferri, Director, Laboratorio Crittogamico ed Osservatorio per le Malattie delle Piante, Via S. Epifanio, 4-Via Scopoli, Pavia.
[To Dr. Ciferri we are also indebted for information on Sardinia.]

NETHERLANDS:
Dr. A. Joan P. Oort, Director, Laboratory of Plant Pathology, Binnenhaven 4, Wageningen.

NORTHERN IRELAND:
Dr. Arthur E. Muskett, The Queen's University of Belfast, Faculty of Agriculture, Elmwood Avenue, Belfast.

NORWAY:
Dr. Toralv Ramsfjell, Norwegian Plant Protection Institute, Div. of Plant Pathology, Botanical Museum, Oslo 45.

REPUBLIC OF IRELAND:
Prof. Robert McKay, Dept. of Plant Pathology, Albert Agricultural College, Ballymun Road, Glasnevin, Dublin, N. W. 3.

SCOTLAND:
Dr. C. E. Foister, Seed Testing, Plant Registration and Plant Pathology Station, Dept. of Agriculture for Scotland, East Craigs, Corstorphine, Edinburgh.

SPAIN:
Josè del Cañizo, Estacion de Fitopatologia Agricola, Avenida de Puerta de Hierro, Madrid.
[To Dr. Canizo we are indebted for information concerning the Balearic and Canary Islands.]

SWEDEN:
Miss B. Persson, Advisory Dept., Statens Växtyskyddsanstalt, Stockholm 19.

SWITZERLAND:
Dr. Blumer, Eidg. Versuchsanstalt für Obst-, Wein- und Gartenbau, Wädenswil.

YUGOSLAVIA:
Dr. Veljko Nikolic, Senior Pathologist in Charge and Deputy Director, Institute for Plant Protection, T. Drajzera 9, Belgrade.

Africa

ALGERIA:
Dr. Pierre Frezal, Chef, Service de la Protection des Végétaux, 137 rue Michelet, Algiers.

ANGOLA:
Dr. Jorge de Barros Rodrigues Queirós, Repartição Central dos Serviços de Agricultura, Luanda.

BELGIAN CONGO:
Le Directeur General en Afrique, Institut National pour 1'Étude Agronomique du Congo Belge, Yangambi.
Dr. R. L. Steyaert, 159 rue des Atrébates, Etterbeek, BruxellesIV, Belgium.

EGYPT:
Dr. Wahib Doss, Director, Ministry of Agriculture, Crop Protection Dept., Plant Disease Section, Giza, Orman.

ETHIOPIA:
Ato Abraham Demere, Director-General, Agriculture Division, Ministry of Agricuture, Addis Ababa.

FRENCH SOMALILAND:
P. Besnault, Service de 1'Élevage et des Industries Animales, Djibouti.

FRENCH WEST AFRICA:
A. Mallamaire, Protection des Végétaux et de la Lutte Antiacridienne, Dakar.

GOLD COAST:
The Director, Department of Agriculture, P. O. Box 299, Accra.

ITALIAN SOMALILAND:
The Administrator, Direzione per lo Sviluppo Economico, Ispettorato Agricoltura e Zootecnia, Mogadiscio.

KENYA:
Dr. R. M. Nattrass, Scott Agricultural Laboratories, Department of Agriculture, P. O. Box 338, Nairobi.

LIBERIA:
Dr. Thomas S. Buchanan, Director of Research, United States of America Operations Mission to Liberia, Monrovia.

LIBYA:
E. M. Sicely, Director, Dept. of Agriculture, Administration of Tripolitania, Tripoli.

MADAGASCAR:
H. Barat, Directeur, Laboratoire de Pathologie Végétale des Services de l'Agriculture, Ambatobe, (Tananarive).

MAURITIUS:
Dr. P. O. Wiehe, Director, Mauritius Sugar Industry Research Institute, Réduit.

MOÇAMBIQUE:
Dr. Tomaz de Carvalho, Chefe, Secção do Serviço de Fitopatologia, Caixa Postal 250, Lourenço Marques.

MOROCCO:
Dr. Perret, Service de la Défense des Végétaux, 65 bis, Avenue de Témara, Rabat.

NIGERIA:
J. M. Thresh, West African Cacao Research Institute, Pathology Division, Moor Plantation, Ibadan.

NORTHERN RHODESIA:
E. A. Riley, Mt. Makulu Research Station, P. O. Box 660, Lusaka.

NYASALAND:
E. L. Drake, Dept. of Agriculture, Zomba.

RÉUNION:
A. Plenet, Contrôleur, Service de la Protection des Végétaux, St. Denis.

SIERRA LEONE:
Dr. F. C. Deighton, Dept. of Agriculture, Njala, via Mano.

SOMALILAND PROTECTORATE:
Dr. J. M. Watson, Director, Dept. of Agricultural and Veterinary Services, Hargeisa.

SOUTHERN RHODESIA:
Dr. G. R. Bates, Branch of Botany and Plant Pathology, Dept. of Research and Specialist Services, P.O. Box 100, Causeway, Salisbury.

SUDAN:
Dr. S. A. J. Tarr, Chief of Plant Pathology, Research Division, Ministry of Agriculture, Wad Medani.

TANGANYIKA TERRITORY:
Dr. George B. Wallace, Dept. of Agriculture, Plant Pathology Laboratory, Lyamungu, Moshi.

TANGIER:
P. Jaubert, Chef, Service Agronomique de Tanger, Tanger.

TUNISIA:
Le Directeur, Service Botanique et Agronomique, Ariana.

UGANDA:
Dr. Barry Baldwin, Dept. of Agriculture, Kawando Research Station, P. O. Box 265, Kampala.

UNION OF SOUTH AFRICA:
Dr. J. M. Kotze, Chief, Div. of Plant Pathology, Dept. of Agriculture, 590 Vermeulen Street, Pretoria.

Asia

ADEN PROTECTORATE:
K. M. Kevvon, Director of Agriculture, Dept. of Agriculture, Aden.

CEYLON:
J. W. L. Peiris, Div. of Plant Pathology, Dept. of Agriculture, Peradeniya.

FEDERATION OF MALAYA:
W. J. Cherewick, Dept. of Agriculture, Kuala Lumpur.

INDIA:
Dr. B. L. Chona, Div. of Mycology and Plant Pathology, Indian Agricultural Research Institute, New Delhi.

IRAQ:
A. R. Adhami, Abu Graib Farm, Abu Graib.

ISRAEL:
Dr. J. Palti, Div. of Plant Pathology, Agricultural Research Station, Rehovot.
Prof. J. Reichert, Head, Div. of Plant Pathology, Agricultural Research Station, Rehovot.

JORDAN:
Dr. Edgar F. Vestal, United States of America Operations Mission to Jordan, Cooperative Dept. for Agricultural Development, Ministry of Agriculture, Amman.

MALAYA: See under Federation of Malaya.

PAKISTAN:
The Director, Dept. of Plant Protection, Block 52, Pakistan Secretariat, Karachi 1.

SYRIA:
A. M. Cicaly, Minister of Agriculture, Ministry of Agriculture, Damascus.

THAILAND:
Kahn Jalavidwana, Chief, Plant Industry Division, Dept. of Agriculture, Bangkok.

TRANS-JORDAN: See under Jordan.

TURKEY:
Dr. Güngör Karel, Institute for Plant Protection, (Ziraat Mücadele Enstitüsü), Ankara.

Australasia and Pacific Ocean areas (excepting U. S. territory or possession)

AUSTRALIA:

New South Wales:

W. S. Sutton, Biological Branch, Dept. of Agriculture, Box 36, G.P.O., Sydney.

Northern Territory:

W. H. Stahl, Agricultural Section, Northern Territory Administration, P. O. Box 231, Darwin.

Queensland:

J. H. Simmonds, Dept. of Agriculture and Stock, Brisbane, B. 7.

South Australia:

N. T. Flentje, Waite Agricultural Research Institute, Univ. of Adelaide, Private Mail Bag, Adelaide.

Victoria:

S. Fish, Biology Branch, Plant Research Laboratory, Burnley Gardens, Swan Street, Burnley, E. 1.

Western Australia:

W. P. Cass Smith, Dept. of Agriculture, Perth.

NEW ZEALAND:

R. M. Brien, Plant Diseases Division, Dept. of Scientific and Industrial Research, Private Bag, Auckland.

TASMANIA:

G. C. Wade, Chief Plant Pathologist, Dept. of Agriculture, Box 673 e, G.P.O., Hobart.

BRUNEI:

L. D. Singh, State Agricultural Officer, Brunei.

INDONESIA:

Frederic P. Hubert, United States of America Operations Mission to Indonesia, Djakarta.

NEW GUINEA: See under Territory of Papua and New Guinea.

NORTH BORNEO:

Director of Agriculture, Dept. of Agriculture, Jesselton.

PAPUA: See under Territory of Papua and New Guinea.

PHILIPPINE ISLANDS:

Felisciano M. Clara, Chief, Plant Pathology Section, Bureau of Plant Industry, Manila.

TERRITORY OF PAPUA AND NEW GUINEA:

A. W. Charles, Acting Superintendent, Lowlands Agricultural Experiment Sta., T.N.G., Keravat. via Rabaul.

South America

BOLIVIA:
Dr. Frank H. Bell, Servicio Agricola Interamericano, Estacion Experimental Agricola, Cochabamba.

BRAZIL:
Dr. Agesilau A. Bitancourt, Director, Divisão de Biologia Vegetal, Instituto Biológico, Caixa Postal 7119, São Paulo.
Anderson C. Andrade, Divisão de Biologia Vegetal, Instituto Biológico, Caixa Postal 7119, São Paulo.

BRITISH GUIANA:
J. S. Spence, Div. of Plant Pathology, Dept. of Agriculture, Georgetown, Demerara.

COLOMBIA:
Dr. Carlos O. Garces, Facultad de Agronomia e Instituto Forestal, Universidad Nacional, Medellín.

PERU:
Mrs. Consuelo Bazán de Segura, Estacion Experimental Agricola de La Molina, La Molina.

SURINAM:
F. A. del Prado, Agricultural Experiment Station, P. O. Box 160, Paramaribo.

URUGUAY:
Celia Boasso, Facultad de Agronomia de Montevideo, Montevideo.

VENEZUELA:
Dr. Warren N. Stoner, Centro de Investigaciones Agronómicas. Departamento de Plagas y Enfermedades, Maracay, El Limón.

Central America

BRITISH HONDURAS:
J. W. D. Goodban, Director of Agriculture, Dept. of Agriculture, P. O. Box 149, Belize.

COSTA RICA:
Ernest H. Casseres, Inter-American Institute of Agricultural Sciences, P. O. Box 74, Turrialba.

El Salvador:
Dr. Bernardo Patino, Ministerio de Agricultura y Ganaderia, Centro Nacional de Agronomia, San Salvador.
Dr. Kenneth H. Garren, U. S. of America Operations Mission to El Salvador, The Institute of Inter-American Affairs, c/o American Embassy, San Salvador.

GUATEMALA:
Marco A. Flores, Instituto Agropecuario Nacional, "La Aurora."
Dr. Francis J. LeBeau, Foreign Operations Administration, Instituto Agropecuario Nacional, "La Aurora."

HONDURAS:
Dr. Albert S. Muller, Dept. of Plant Pathology, Univ. of Florida, Gainesville, Florida.

Bermuda; West Indies, Caribbean Region

BERMUDA:
W. R. Evans, Director of Agriculture, Dept. of Agriculture, Agricultural Station, Paget East.

BRITISH WEST INDIES:
Jamaica;
A. Naylor, Plant Protection Division, Dept. of Agriculture, Hope, Kingston.

Trinidad:
B. G. Montserin, Deputy Director of Agriculture, Agricultural Department, Central Experiment Station, c/o Arima Post Office.

CUBA:
T. G. Bryans, Casa Turull, Havana.

DOMINICAN REPUBLIC:
Miguel A. Baez Dias, Secretario, Secretaria de Estado de Agricultura, San Cristóbal, Ciudad Benemarita, P. T.

REPUBLIC OF HAITI:
Félix Pierre-Louis, Service de Enseignement et Experimentation Agricoles, Département de l'Agriculture, Port-au-Prince.

North America
(including U.S. possessions in other areas)

CANADA:
Dr. I. L. Conners, Div. of Botany and Plant Pathology, Dept. of Agriculture, Science Service Building, Ottawa.
Dr. K. M. Graham, Div. of Botany and Plant Pathology, Dept. of Agriculture, Science Service Building, Ottawa.

MEXICO:
R. W. Richardson, Jr., The Rockefeller Foundation, Div. of Natural Sciences and Agriculture, Calle Londres 45, Mexico 6.

GUAM:
Dr. O. N. Liming, Acting Director of Agriculture, Government of Guam, Agana.

PUERTO RICO:
Dr. Thomas Theis, U.S. Dept. of Agriculture, Federal Experiment Station, Mayaguez.
Dr. Luis A. Alvarez, Agricultural Experiment Station, Rio Piedras.

TERRITORY OF HAWAII:
Dr. Harry H. Murakishi, Head, Dept. of Plant Pathology, University of Hawaii, Honolulu 14.

General Index

	First Report	Distribution	Spread	Damage	Control	Strains
(Africa cont.)						
Northern Rhodesia	21	--	--	--	--	--
Nyasaland	21	--	--	--	--	--
Réunion	21	24	26	27	28	--
Sierra Leone	21	--	--	--	--	--
Somaliland Protectorate	21	24	26	27	28	--
Southern Rhodesia	21	--	--	--	--	--
Sudan	21	--	--	--	--	--
Tanganyika Territory	21	24	26	27	28	29
Tangier	21	--	26	27	28	29
Tunisia	21	--	26	--	--	--
Uganda	21	--	--	--	--	--
Union of South Africa	21	24	26	27	28	29
Bibliography: 29-30						
ASIA:						
Aden Protectorate	31	--	--	--	--	--
Ceylon (with India)	31	32	--	--	--	--
Federation of Malaya	31	32	34	35	36	36
India	31	32	34	--	--	36
Iraq	31	--	--	--	--	--
Israel	31	33	34	35	36	36
Jordan	31	33	35	35	36	36
Malaya: See under Federation of Malaya.						
Pakistan (with India)	31	32,(33)	--	--	--	--
Syria	31	34	35	35	36	--
Thailand	31	--	--	--	--	--
Trans-Jordan: See under Jordan.						
Turkey	31	--	--	--	--	--
Bibliography: 37-38						
AUSTRALASIA AND PACIFIC OCEAN AREAS (excepting U.S. territory or possession):						
Australia	39	40	42	43	44	44
New Zealand	39	40	42	43	44	45
Tasmania	39	41	42	43	44	45
Brunei	39	--	--	--	--	--
Fiji	39	--	--	--	--	--
Indonesia	39	41	43	43	44	--
New Guinea: See under Territory of Papua and New Guinea.						
North Borneo	39	--	--	--	--	--
Papua: See under Territory of Papua and New Guinea.						
Philippine Islands	39	41	43	43	--	--
Territory of Papua and New Guinea	39	--	--	--	--	--
Bibliography: 45-46						
SOUTH AMERICA:						
Argentina	47	--	--	--	--	--
Bolivia	47	--	--	--	--	--
Brazil	47	48	50	51	51	52
British Guiana	47	--	--	--	--	--
Colombia	47	48	50	51	51	52
Ecuador	47	--	--	--	--	--
Peru	47	49	50	51	51	52
Surinam	47	--	--	--	--	--
Uruguay	47	49	50	51	51	52
Venezuela	47	49	50	51	51,52	52
Bibliography: 52-53						

	First Report	Distribution	Spread	Damage	Control	Strains
CENTRAL AMERICA:						
British Honduras	--	54	--	--	--	--
Costa Rica	54	54	56	56	57	57
El Salvador	54	54	56	56	57	57
Guatemala	54	55	56	56	57	57
Honduras	54	55	56	56	57	57
Bibliography: 58						
BERMUDA; WEST INDIES; CARIBBEAN REGION:						
Bermuda	59	--	--	--	--	62
British West Indies						
Jamaica	59	59	60	61	61	62
Montserrat	59	--	--	--	--	--
Trinidad	59	--	--	--	--	--
Cuba	59	59	60	61	61	62
Dominican Republic	59	60	60, 61	61	61	62
Republic of Haiti	59	60	61	61	62	62
Bibliography: 62-63						
NORTH AMERICA (including U.S. possessions in other areas)						
Canada	64	65, 66	68		69	70
Mexico	64	66	68	69	69	70, 71
United States	64	67	68	69	69, 70	71
Guam	64	--	--	--	--	--
Puerto Rico	64	67	68	69	70	71
Territory of Hawaii	64	67	68	69	70	71
Bibliography: 73-75						

PLANT DISEASE EPIDEMICS AND IDENTIFICATION SECTION, HORTICULTURAL CROPS RESEARCH BRANCH, AGRICULTURAL RESEARCH SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE, PLANT INDUSTRY STATION, BELTSVILLE, MARYLAND

11886.1 5-51 (Second Revision 2-54)